POSIT

Principles for One-Stop Information & Training

"If it isn't usable, they won't."

Handbook of Usability Principles

Edited by

Brock S. Allen, PhD
Professor of Educational Technology
San Diego State University

Steven L. Eckols, MA
Lecturer in Educational Technology
San Diego State University

Center for Learning, Instruction, & Performance Technologies

San Diego State University *http://clipt.sdsu.edu*
voice: 619.594.5439

Disclaimer

The research summaries and other information contained in this database reflect the opinions of the POSIT development team members and do not necessarily reflect the policies or opinions of San Diego State University or the State of California.

Development team

Writers and editors

Brock Allen
Amy Brown
Steven Eckols
Don Jania-Smith
Sharon Jones
Susan Levine
Kendra Sheldon

Researchers

Carl Fielden
Don Jania-Smith
Sharon Jones
Susan Levine
Cindy Nelson
Amy Strommer
Mark Warmbrand
Michelle Warn
Merry Woodruff

Table of contents

Introduction

In today's information age, usability is critical to almost every new product or service. Most of the principles and guidelines in this handbook can be applied in a wide range of settings—from schools and museums to factory floors and public transportation systems. However, we created this handbook specifically to support California's "one-stop system," a network of public and private agencies and organizations dedicated to improving services to employers and job, education, and training seekers.

POSIT: Principles for One-Stop Information and Training

> **posit** \pawsit\ 1. to dispose or set firmly: FIX.
> 2. to assume or affirm the existence of: POSTULATE.
> 3. to propose as an explanation: SUGGEST.

Usability is a central issue for anyone involved in building capacity for one-stop systems. Why? Because no matter how well-intentioned, one-stop services will fail if customers can't use these services. It's that simple. And as computers and telecommunications come to play a larger role in one-stop services, awareness of usability issues will become even more important.

POSIT was funded by the State of California through a contract with the Center for Learning, Instruction, and Performance Technologies at San Diego State University. POSIT was developed as a pilot project to provide suggestions and advice to electronic one-stop system (EOS) managers and staff who need to know more about a range of usability issues—from ergonomics and screen design to readability and access for persons with disabilities.

Formulated as "practitioner-oriented principles," relevant to practical decisions, the information in this handbook is also available on the world-wide web as a searchable database with multimedia examples (http://clipt.sdsu.edu).

What's usability got to do with it?

The magnitude and diversity of California's population and the complexity of proposed EOS services could make California's proposed electronic one-stop system one of the most ambitious systems of computer-based customer-support services ever attempted.

In any case, no other aspect of electronic one-stop services will so define public perception as will usability or, roughly speaking, "user-friendliness." This critical issue was a consistent theme in the POSIT team's analysis of public testimony and summaries of focus group studies reported in Building an Electronic Infrastructure for California's One-Stop System.

As the authors of this report noted,

> "be user-friendly" was the repeated message expressed by all customer groups....Point-and-click graphics, easy-to-use application software was top on the service providers' wish list.

Usability is not easily achieved, and no competent usability engineer ever assumes that "usability" is some factor that can simply be paid for and "designed" into a planned product while the product is still on the drawing boards. Rather, the overwhelming consensus is that usability results from sustained and constructive relationships between communities of users and communities of developers in which the "fit" between products/services and customers evolves through iterative design processes.

Simply put, the evolution of usable electronic one-stop services will depend on a culture of one-stop personnel who understand and care about usability issues.

There is another reason for attending to usability issues early in the planning stages for electronic one-stop services. When customers have problems with electronic one-stop services, the obvious solution is for human agents to lend a hand with supportive and facilitative interventions. The very nature of computer software means that human facilitators must understand what might have gone wrong and how to help. This is clearly not as simple as "showing customers what to do," but will often require some sophistication in factors and processes that govern human-computer interactions. Understanding usability will be critical for system planners and implementers, but it is no less critical for the personnel charged with immediate customer support responsibilities.

Suggestions on using the handbook and database

The printed handbook is divided into seven major sections, each covering a major usability topic. Each section has its own table of contents, so that it can be detached and duplicated for separate distribution to support specialized discussion at a staff meeting or as part of a workshop.

The on-line database contains the same text content as the handbook, and also includes 20 multimedia examples. The database also offers additional search tools. For example, you can list principles by EOS role (planner, manager, product developer, customer support personnel). Or you can search by factors such as desired outcomes or type of customer.

Current scope of the POSIT handbook and database

We formulated information in the handbook as “practitioner-oriented principles”—guidelines and ideas about what to do rather than theories or abstract concepts. Readers who want more information or who want to dig deeper into the theory and research that supports these principles should consult the readings listed at the end of many of the principles.

Since POSIT is a pilot project, the handbook and database do not provide definitive answers to every usability challenge, nor do they represent a comprehensive survey of all usability issues. Rather, they are samplers of expert opinion on a range of representative usability issues.

We designed the handbook and database to start a conversation. Continuation funding will support expansion and refinement of the POSIT database, experimentation with models for training site-based personnel, and a variety of forums for on-line discussion. We invite you to become part of this discussion at http://clipt.sdsu.edu

Brock Allen,
Director

Steve Eckols,
Research Associate

Center for Learning, Instruction, &
Performance Technologies

January 15, 1997

1. Universal access

Universal access means creating adaptable technical and physical environments that meet the needs of all customers. Given California's diverse population, this presents a challenge. This section gives you the tools to meet the challenge. The first step is to design a system interface that puts learners at ease in the hypertext environment. An effective interface is simple, flexible, and natural to use. Built-in memory aids, forgiveness, and immediate feedback help users learn the system. Objects and principles imported from the physical world encourage instinctive use of the system. This section will also help you to create a work environment that adapts to the needs of your customers.

1.1 Make systems easy and natural to use

1.1.1 Keep the interface simple

Keep the interface simple because simplicity reduces the demand on users' brain power and focuses users' attention on the task.

Strive for simplicity in layout, screen function, structural design and other program elements. Complex or extraneous interface elements unnecessarily burden users' working memory.

Guidelines for keeping an interface simple include:

- **Screen function** Each screen should present a meaningful group of procedures or information. On each screen, the user should either complete a task or a whole part of a task, or study a meaningful group of related information. For example, a procedural screen would allow users to create all or a major section of a resume; an informational screen would list companies where a particular job is available.

- **Structural design** Organize and present information or processes in a straightforward, simple manner. Group related processes together. Minimize complexity in links within and between groups of information or processes.

- **Layout** Present objects, information, and procedures in meaningful groups according to how or when they will be used. For instance, group all navigational tools together. Use spacing, size, color, alignment, and other visual devices to organize screen elements. Eliminate extraneous screen elements.

1.1.2 Reduce users' memory load by providing memory aids

Computers are better than humans at recalling and retrieving detailed information. Our working memory is short-lived.

To reduce the burden on users' working memory and allow them to concentrate on a particular task, you should allow users to store information in the computer that they may need or want in subsequent activities.

Provide users with tools that enable them to store and retrieve personalized information. This customization can accommodate individual differences in skill levels, learning styles, language and culture. Personalized storage tools can include:

- **Electronic bookmarks** let users record locations in a program or on the Internet that the users want to access quickly, without having to search.
- **Electronic notepads** let users record information they want to remember later, such as other computer tasks they need to remember to do or notes about how to perform some procedure on the computer.
- **History records** document users' paths through a program or system that let them retrace their paths.
- **Recent document functions** log recently used files and let users quickly find them without having to remember their names.

Reduce users' need to remember how to perform specific actions and procedures by providing the following types of tools or devices:

- **Lists of codes and their meanings** (for example, MN is the state code for Minnesota).
- **Lists of choices** such as menus containing program functions.
- **Instructions** for completing data-entry tasks.
- **Balloon helps** that explain objects on the screen.

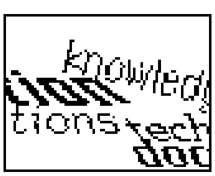
1.1.3 Reduce information overload

Reduce information overload and task complexity by adopting the maxim that when information is out of sight, it is out of mind.

Timing is critical in the display of tools and information. Users may become confused or frustrated if they select options that are inappropriate for the current task. Users may also expend unnecessary cognitive effort if presented with irrelevant tools or information.

Make complex systems seem simpler by only presenting information relevant at a given time. Use progressive disclosure: reveal information to the user in small, manageable amounts. Progressive disclosure tools—pop-up boxes, pull-down menus, and hierarchical menu displays—allow users to digest small bits of information at a time.

Help users make the right decisions by reducing available choices. Hide tools that aren’t needed at a particular time or show that they are inactive by graying them out.



To see a multimedia example that illustrates this principle, point your web browser to:

http://clipt.sdsu.edu/posit/ex/0005.html

1.1.4 Give computer users a seat with a view

The human eye focuses better at a distance than close up. Working at a computer monitor forces eye muscles to stay on a tighter focus, which can cause eye strain. Therefore, workstations should be designed so computer users can take regular eye breaks by focusing on objects at least 15 feet away.

Workstations should be placed so that users can look at objects across the room. Confining computers within cubicles or on desks against walls limits the ability of users to relax their eyes momentarily by focusing at a distance. If office space is divided into cubicles, make sure the partitions are low enough so customers can see over the dividers when seated. Remind customers to take regular eye breaks.

Further readings

Katz, L. J. (1993). Visual discomfort and visual changes associated with VDT usage. Unpublished master's thesis, San Diego State University, San Diego, CA.

Mahnke, F. H., & Mahnke, R. H. (1987). Color and light in man-made environments. New York, NY: Van Nostrand Reinhold Company.

1.1.5 Provide adjustable monitors

In public-access environments, computer users should be able to easily adjust the height and angle of workstation monitors.

Customers should be able to adjust the position of the monitor to eliminate any reflections from the screen. Reflections contribute to eye strain and fatigue. Customers who wear bifocals should be able to adjust the position of the monitor so that they can focus through one of the lens segments rather than through the line between the segments in their glasses.

Many monitors come with adjustable bases that allow users to adjust the angle of the screen. Although these do not provide for adjustments in height, they are an improvement over earlier fixed monitors. There are also special racks that allow users to adjust the height and angle of the monitor. However, these racks are suited only for smaller monitors.

Further readings

Jaschinski-Kruza, W. (1991). Eyestrain in VDU users: Viewing distance and the resting position of ocular muscles. Human Factors, 33(1), 68-83.

Osborn, D.J. (1987). Ergonomics at work. Chichester, NY: John Wiley.

Peterson, B., & Patten, R. (1995). The ergonomic PC: Creating a healthy computing environment. New York: McGraw Hill.

1.1.6 Accommodate differences in vision

Arrange workstations so customers can personalize the viewing range, angle and height of the computer screens.

Viewing range is the distance between a person's eyes and the computer screen. A person's ability to focus on near objects decreases with age. One study revealed that optimal viewing distance ranged between about 20 and 40 inches. Customers of different ages may need different viewing distances .

Adjustable viewing angle and height are important to customers who wear bifocals. These lenses offer two prescriptions: one for close-up work and another for distance. The dividing line between the segments can be very distracting unless the customer can adjust position relative to the screen so he/she can focus comfortably through one of the lens segments.

Ergonomically-designed chairs provide computer users with the flexibility needed for comfortable screen viewing. There is a wide selection of these chairs available. Some of the more inexpensive models are on rollers and have adjustable heights. Recommended seat height range is between 16 and 20.5 inches.

Further readings

Jaschinski-Kruza, W. (1991). Eyestrain in VDU users: Viewing distance and the restring position of ocular muscles. Human Factors, 33(1), 68-83.

Osborn, D.J. (1987). Ergonomics at work. Chichester, NY: John Wiley & Sons.

Peterson, B., & Patten, R. (1995). The ergonomic PC: Creating a healthy computing environment. New York, NY: McGraw Hill.

1.1.7 Vary lighting according to workers' needs

When you type on a computer, you need less illumination than when you shuffle through paper documents. For this reason, workstations should allow customers to tailor the lighting to their needs.

The American Optometric Association recommends a level of between 20 and 50 foot-candles for a computer workstation, which is about half the illumination provided in most offices. But customers using computer workstations will often want to take notes, which requires sufficiently lit desk surfaces.

To meet the varying illumination needs, provide variable intensity lights or moveable shields that allow the customers to adjust the amount of light in the workstation area.

Further readings

Mahnke, F.H., & Mahnke, R.H. (1987). Color and light in man-made environments. New York, NY: Van Nostrand Reinhold Company.

Osborne, DJ., & Gruneberg, M.M. (1983). The physical environment at work. New York, NY: John Wiley & Sons.

Peterson, B., & Patten, R. (1995). The ergonomic PC: Creating a healthy computing environment. New York, NY: McGraw Hill.

To see a multimedia example that illustrates this principle, point your web browser to:

http://clipt.sdsu.edu/posit/ex/0030.html

1.1.8 Consider eye strain from reflected light

Reduce eye strain by placing computer monitors at right angles to major sources of light. This means windows should be to the left or right of the computer users rather than in front or behind them.

This is important because reflected light from a window or other light source can lead to eye strain. Computer monitors, with their smooth glass surfaces, act like mirrors, reflecting sunlight from windows into the users' eyes. Obviously, this makes it more difficult for the user to read the screen because the reflected image may compete with the image produced by the computer.

In your efforts to make sure a window doesn't reflect onto a computer screen, don't place the computer facing a window. Unless the window is tinted or has curtains or shades, the contrast in lighting between the work area and the window view may contribute to eye strain.

Further readings

Mahnke, F.H., & Mahnke, R.H. (1987). Color and light in man-made environments. New York, NY: Van Nostrand Reinhold Company.

To see a multimedia example that illustrates this principle, point your web browser to:

http://clipt.sdsu.edu/posit/ex/0030.html

1.1.9 Avoid contrasts in brightness in workstations

To reduce eye strain, avoid large contrasts in the working environment, especially office walls and desk surfaces.

Avoid white walls, which can produce extreme contrasts in brightness with other objects in the work area and may cause distracting reflections on computer screens.

The surface of desks and work areas should ideally be a medium gray matte finish. This finish prevents extreme contrasts between printed documents and the background surface and reduces glare from overhead lights.

Extreme contrasts in brightness contribute to eye strain because the eye receives mixed messages on how to adjust the amount of light being admitted through the pupil.

Further readings

Mahnke, F. H., & Mahnke, R. H. (1987). Color and light in man-made environments. New York, NY: Van Nostrand Reinhold Company.

Osborne, D. J., & Gruneberg, M. M. (1983). The physical environment at work. Chichester, NY: John Wiley & Sons.

To see a multimedia example that illustrates this principle, point your web browser to:

http://clipt.sdsu.edu/posit/ex/0030.html

1.1.10 Clear areas behind computer monitors

Arrange workstations so that no one works directly behind a computer monitor.

Research into electromagnetic radiation from computer monitors has not produced conclusive findings about the potential health threat, but there is enough evidence to warrant caution. Studies show that more electromagnetic radiation is emitted from the rear than from the front of a computer monitor.

Workstations should reduce the potential risk to computer users by providing clearance behind computer monitors. This precaution is especially important when older computers are being used. More stringent standards have encouraged many manufacturers to build low-emission monitors that reduce the potential electromagnetic radiation hazard.

Further readings

Hughs, M.M. (1990). Computer health hazards. Washington, D.C. Hughs Press.

Peterson, B., & Patten, R. (1995). The ergonomic PC: Creating a healthy computing environment. New York, NY, McGraw Hill.

1.1.11 Accommodate left-handed mouse users

Workstations should provide space on both the right- and left-hand sides of the keyboard so customers can use a mouse on either side.

Approximately 10 percent of the population is left-handed. In order to provide all customers with equal access to software requiring the use of the mouse, the workstation should enable customers to use a mouse with either hand. Software that uses multiple mouse buttons should have simple options to reverse the order of the buttons for left-hand use.

Further readings

Peterson, B., & Patten, R. (1995). The ergonomic PC: Creating a healthy computing environment. New York, NY: McGraw Hill.

1.1.12 Help users by providing default settings

Learning a new software package can be a tedious process. Make it easier on your customers by providing default settings that anticipate their choices.

This will give users guidance and enable them to become familiar with the most common functions of a program quickly.

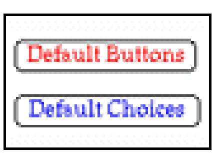
Logical choices that users frequently make should be set as defaults. Users should be able to select defaults by simple actions, like pressing the enter key.

In a public-access environment, with many computer users, set up software systems so users can easily return to default values. Thus, if a previous user has reset the options and a current customer is not sure what the common settings are, she/he could reset the system to the default values.

Further readings

McDonald, J.E., Dayton, T., & McDonald, D.R. (1988). Adapting menu layout to tasks. International Journal of Man-Machine Studies, 28, 417-435.

Oppermann, R. (1994). Adaptive user support: Ergonomic design of manually and automatically adaptable software. Hillsdale, NJ: Laurence Erlbaum Associates.



To see a multimedia example that illustrates this principle, point your web browser to:

http://clipt.sdsu.edu/posit/ex/0013.html

2. Search and navigation

The terms **search** and **navigation** take on new meaning in a hypertext environment. Computer users often feel disoriented or lost in cyberspace. This section helps you guide customers through "uncharted territory" with navigational tools and search strategies. Maps, diagrams, marked paths and guided tours orient users within the system. Learners can reach their destinations with multiple search engines and tools, while safety nets prevent irreversible errors. A well-designed system provides an atmosphere in which users search and navigate with confidence. POSIT principles help customers get what they need in cyberspace without getting lost.

2.1 Design logical, natural interfaces for computer interactions

2.1.1 Make the interface consistent

When a software program's interface is consistent, the program is easier to learn—and users become familiar and comfortable with the program more quickly.

Don't make users relearn unimportant, background information with every new screen. Maintain consistency in all aspects of the program, including:

- screen layout,
- function of navigational elements,
- use of language, graphics, and sounds,
- metaphors, and
- feedback mechanisms.

This is important because people have to work harder mentally to process changes in a dynamic environment than in a stable environment. A dynamic environment burdens memory and recall. In more technical language, it drains people's "cognitive processing capacity."

A software program's interface is the computer's "environment." You'll make the most of a computer user's mental abilities if you provide a stable interface. A consistent interface allows the user to focus on the task at hand, rather than on the tool—the software program—he / she is using to accomplish the task.

Consistency also creates a sense of familiarity and comfort, and it reduces the disorientation that may come with being in a new learning situation. Performance improves when computer users recognize that there are elements—such as navigational buttons—conveying standard actions or meanings throughout the program. Consistency within the interface also allows users to better judge how an unfamiliar function works, based on their knowledge of similar functions.

Consistency does not mean total uniformity. Use variations when they are meaningful. For instance, you may want to use a different background or text color to distinguish sections or categories of information.

2.1.2 Make sure the interface tells how to use the system

Physical characteristics of objects in our environment give clues for how to interact with them. A flat, horizontal rock may invite someone to sit on it. Similarly, a ball might invite us to roll it; a switch, to toggle it; or a button, to press it.

You should design the user interface, the bridge between a person and a computer system, so it leads users to take correct actions. A keyboard suggests pressing keys; if users press a key, they discover that the corresponding letter appears on the monitor screen. A pointer suggests the selection of one thing among many. If users click the mouse when the pointer is pointing to a filename icon, the filename becomes highlighted, indicating that the file is selected.

Although the function of interface elements may not be obvious at first, their characteristics should let users easily learn and work with them after brief instruction. Users should be able to experiment with actions and discover what happens as a result. Make all actions reversible to encourage such experimentation.

To make the interface communicate functional information, use these guidelines:

- Make all interface elements, or objects, that initiate actions obvious. Give all objects clear boundaries. For instance, provide buttons or icons for the user to select with the mouse; do not require the user to point and press the mouse in an unmarked part of a window to activate a function.

- To the extent possible, the appearance and location of interface objects should give information about their functions.

- Objects with similar functions should look similar. For example, show navigational tools as buttons of the same size and color.

- Use layout and other graphic properties to suggest the functions of objects. For instance, group objects with similar functions together; put a border around the group.

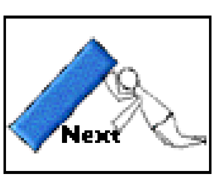
- Make the current status of the program obvious. Provide immediate feedback so users know the results of their actions. Clearly indicate what functions are not currently available by changing the appearance of the corresponding objects. For instance, show menu labels of inactive functions in gray instead of black.

- Use text labels to clarify the functions of interface elements. For instance, put a text label on a button.

Experts say well-designed screens increase human processing speed, reduce human errors and speed computer processing time.

Further readings

Norman, D. (1988). The psychology of everyday things. New York: Basic Books.



To see a multimedia example that illustrates this principle, point your web browser to:

http://clipt.sdsu.edu/posit/ex/0015.html

2.1.3 Provide feedback

Interaction with a computer is a two-way street. Provide informative and timely feedback to let computer users know that the system is responding to their actions.

Use visual and auditory indicators to notify and reassure users that the system is reacting as they explore and interact. For instance, highlight or animate buttons, menus or icons when users activate them. Use messages or animation to let users know the system is working during what appears to them to be a delay.

Provide feedback for every action. If the users move the mouse, the cursor moves. If they type on the keyboard, the typed letters appear on the screen. Communication should be brief, direct, and expressed from the user's perspective.

When informative and timely feedback is provided, users will begin to learn what is and is not possible within the software system, and they will become more productive and confident with the program. Clear, appropriate, and timely feedback reduces user errors.

2.1.4 Let software be forgiving of users' mistakes

Create a safety net in a software program by enabling every action to be reversible. Users should be allowed to take risks and make mistakes without dire consequences. By building in forgiveness, you will encourage users to explore the territory without fear of breaking or ruining anything.

Users are more productive and confident with a program that they feel they can safely explore. Forgiveness encourages users to independently learn new programs by trying out new functions and processes. Users are bound to make mistakes, so let them change their minds. Warn users if an activity is not reversible, and allow them to choose whether to proceed or not.

2.1.5 Use metaphors to make the unfamiliar familiar

Use metaphors to convey functions and features of a software operating system in a way that takes advantage of people's knowledge of the world around them.

You use a metaphor whenever you make a reference connecting one object or process to another object or process. For instance, the phrase “March comes in like a lion and leaves like a lamb” uses familiar animals to describe the blustery weather at the beginning of March and the milder weather at the end.

In a computer environment, metaphors should involve concrete, familiar ideas that are found in everyday life and should point to ways of interacting with the system. For instance, many on-line help systems are like books because they contain tables of contents and indexes that help users find sections of information or specific topics. Also, users usually go through the “pages,” or screens, sequentially, as they would a book.

Other metaphors that most people are familiar with include: a town, a house with different rooms, a meal, or a family occasion. These metaphors work because they’re based on concrete, real-world concepts or processes.

Metaphors should be consistently supported throughout the program. If the program uses a metaphor of a television (with channel switching and video-tape recording machines), it shouldn’t mix in objects from a movie theater (a film projector or movie tickets).

You may never find a perfect match between metaphors and system functions. Although metaphors can make interfaces more accessible, it is better to have no metaphor at all than one that is badly matched and misleading. While useful, metaphors are not mandatory to good interface design. Software should provide ways of “undoing” errors resulting from misinterpretations of the metaphor’s application.

2.2 Provide the best ways for customers to find answers to their questions

2.2.1 Offer multiple search strategies in on-line environments

Search systems that satisfy one type of user may frustrate others. And search strategies that satisfy one user one day may frustrate her or him on another day, when the information is broader or more narrowly defined.

You should provide flexible interfaces to accommodate the various factors involved with users searching for information.

The search system a user chooses will depend on his or her knowledge of the subject area, previous experience conducting searches, general cognitive abilities, and expectations about the answer. In the non-electronic world, information seekers often use more than one search system, such as the reference librarian, the card catalog, and browsing through the stacks. Similarly, in on-line environments, users need to be able to use multiple search strategies.

There are two major strategies for locating information in an on-line environment. Users can browse informally through a database, which is an interactive experience that requires less effort from the user. Or users can adopt analytical approaches, which are formal, goal-driven approaches that require careful planning and recall of query terms. Most people prefer to browse. Analytical strategies are more efficient in large databases, but are harder to learn; they also tend to require more effort from the user. This is especially true for search features such as Boolean connectives, string search, proximity limits, and truncation. Studies have repeatedly shown that users prefer informal, interactive strategies; however, systems that provide only browsing features are typically inefficient for directed search tasks or fact retrieval.

Researchers have identified five main interaction styles. The following table presents advantages and disadvantages of each:

Interaction style	Advantages	Disadvantages
Menu selection	Requires less time to train users; reduces the number of keystrokes needed; structures the user's decision making; permits use of dialog-management tools; easily supports error handling.	May slow down frequent users; requires screen space and rapid display rate.
Form Fill-In	Simplifies data entry; requires modest training; makes assistance convenient; shows context for activity; permits the use of form management tools.	Consumes screen space; requires typing skills.
Command Language	Has flexibility; supports user initiative; appeals to power users; potentially rapid for complex tasks; supports macro capability.	Requires substantial training; information is difficult to retain; handles errors poorly.
Natural Language	Relieves the user from the burden of learning syntax.	Requires clarification dialog; may require more keystrokes; may not show the context; is unpredictable.
Direct Manipulation	Visually presents the task to the user; easy to learn and remember; encourages exploration; errors can be avoided; has high subjective satisfaction.	May require graphics display/pointing devices; may require more programming effort until tools improve; may be hard to record history or write macros.

Further readings

Savoy, J. (1993). Searching information in hypertext systems using multiple sources of evidence. International Journal of Man-Machine Studies, 38, 1017-1030.

Marchionini, G. (1995). Information seeking in electronic environments. New York: Cambridge University Press.

Marchionini, G., & Shneiderman B. (1988, January). Finding facts vs. browsing knowledge in hypertext hystems. Computer Magazine, 71-80.

Shneiderman, B. (1995). A taxonomy and rule base for the selection of interaction styles: Readings in human-computer interaction, toward the year 2000. San Francisco: Morgan Kaufmann.

2.2.2 Let users search by browsing in hypertext documents

Browsing is the flexible exploration of the content of a program. It includes scanning, observing, navigating, and monitoring. Mentally, it's easier to browse than to use traditional search strategies, such as a keyword search.

You should build support for browsing into an on-line hypertext system, since most users, especially novice or infrequent users, prefer to browse for information rather than use analytical search strategies, which are generally planned and goal driven. Browsing through electronic databases allows users to clarify problems and develop strategies for solving them. Browsing also facilitates discovery and learning.

Browsing is particularly effective when users are gathering overview information on a topic or when a problem is ill-defined or interdisciplinary. Research has shown that users, even novices, can effectively conduct queries by navigation, if they are provided with a dynamic table of contents or a hyperindex that they can use as a springboard for their searches. This technique is less effective with large databases.

Designers can build support for browsing into an electronic system. The following features and techniques support electronic browsing:

Conceptual displays:

- document structures such as outlines;
- alternative levels of detail (summaries, abstracts);
- alternative views (indexes, filters);
- maps, webs, paths, tours; and
- neighborhoods or clusters of related ideas or topics.

Physical displays

- text features (highlights);
- color / shape / positional cues;
- multiple, coordinated windows;
- link anchors (hot words);
- icons, fisheye views;
- thumbnail miniatures;
- three-dimensional perspectives;
- compressed images; and
- animation.

User controls

- display manipulation (scroll, jump);
- zooms and pans; and
- usage monitoring (histories, bookmarks).

Query styles

- text queries (string search, guess-and-go);
- selection (hierarchical menus);
- graphical queries; and
- feedback on relevance of “hits” to likely user goals.

Browsing does have its limitations. Disadvantages include the possibility that users may be distracted by irrelevant material or face information overload. In addition, if users rely on browsing, their searches may result in a superficial perspective on a limited portion of the available information.

Further readings

Campagnoni F. R., & Ehrlich K. (1989). Information retrieval using a hypertext-based help system, ACM Transactions on Information Systems, 7(3), 271-291.

Chimera, R., & Shneiderman, B. (1994). Evaluation of three interfaces for browsing large hierarchical tables of contents. ACM Transactions on Information Systems, 12(4), 383-406.

Marchionini, G. (1995). Information seeking in electronic environments. New York: Cambridge University Press.

2.2.3 Use a dynamic table of contents for hypertext

In a hypertext environment, you should provide aids, such as dynamic tables of contents, for users who want to browse through the database.

Many hypertext users prefer to browse rather than to use analytical strategies such as query formulation. Tables of contents, with their hierarchical representations of the information in the database, stimulate browsing. In a print world, tables of contents are one-dimensional and stable; in an electronic environment, they don't have to be. In fact, tables of contents that are somehow dynamic are more effective in a hypertext environment. Examples of dynamic tables of contents include those that expand and contract, and those that utilize multiple panes.

The problem with a stable interface is that it usually requires that users scroll to see all of the chapter titles. A dynamic table of contents enables the user to perceive the overall hierarchical organization of the text. The dynamic interface maintains the logical structure and context of the representation. When a user chooses to expand a chapter title, the preceding chapter titles remain visible on the screen. The multipane interface offers continual display for high-level chapter and section information. A user could also use a dynamic table of contents as a base. This would reduce the possibility of getting lost while navigating through the database.

Further readings

Chimera, R., & Shneiderman, B. (1994). Evaluation of three interfaces for browsing large hierarchical tables of contents. ACM Transactions on Information Systems, 12(4), 383-406.

2.2.4 Create query systems to search large hypertext databases

Browsing is the most popular style of information-seeking in hypertext environments, and it's sufficient for small hypertext systems. Navigation by browsing is particularly effective when the user's goal is ill-defined or when the goal is to get an overview of a topic.

However, if a topic is narrow or the database is particularly large, the designer should provide users with analytical methods of information gathering. These methods include string search, Boolean logic queries, ranking of results, and relevance feedback. Designers should be aware, however, that studies indicate that many people have difficulty with formal (Boolean) logic queries.

Further readings

Balasubramanian, V. (December, 1993). State of the art review on hypermedia issues and applications (chapters 4 & 9). Internet: http://www.isg.sfu.ca/~duchier/misc/hypertext_review/

Conklin, J. (1987, September). Hypertext: An introduction and survey. IEEE Computer, 17-41.

Ehrenreich, S. (1980) Design recommendations for query languages. Alexandria, VA: US Army Research Institute for the Behavioral and Social Sciences.

2.2.5 Use multiple indexing methods to support users' searches

To retrieve information from a database, a computer user must have general understanding of its contents. There are indexing systems that cluster similar or related keywords, and those that allow users to search the entire database. You should include a combination of indexing methods in hypertext programs, as different methods result in different outcomes.

The traditional way to represent information documents in large collections is to use simple indexing to aid the user's search. Each document is assigned one or more index terms to describe its contents; users then make queries of the index terms to locate the documents. The index terms are often located in a searchable or scannable index file. The problem with simple indexing is that the term descriptors are often not specific enough. When combined into term phrases, they may retrieve too many items or no items at all. In CD-ROMs and on the Internet, indexes increasingly contain all the words contained in the entire collection of documents; this is called full-text indexing.

Because there are many ways to refer to the same concept, computers should use synonyms in interpreting command languages and in documentation indexes. Suggestions from researchers include using a thesaurus as an indexing aid to group related terms; designing the system to expand its index of terms to include aliases suggested by users; combining single terms into compound terms, representing relatively fixed concepts; and representing the structure of index terms.

Further readings

Balasubramanian, V. (December, 1993). State of the art review on hypermedia issues and applications (chapters 4 & 9). Internet: http://www.isg.sfu.ca/~duchier/misc/hypertext_review/

Nielsen, J. (1993). Usability engineering. New York: Academic Press Inc. Harcourt Brace & Co.

Savoy, J. (1993). Searching information in hypertext systems using multiple sources of evidence. International Journal of Man-Machine Studies 38, 1017-1030.

Marchionini, G. (1995). Information seeking in electronic environments. New York: Cambridge University Press.

2.2.6 Provide guided tours or predetermined paths

To help users learn a hypertext system, designers should include guided tours or predetermined paths.

Guided tours and predetermined paths help users understand the structure of a system. They also help users determine opportunities for movement within a given Web page or the hypertext system as a whole. A structured overview also reduces the likelihood of users becoming "lost" or "disoriented."

In a hypertext system, paths refer to a set of predetermined links within the informational space created by the author. Providing paths within a hypertext system enables users to interact with information in sequences recommended by the author. Studies suggest that when readers are allowed to select what text to read, they may sequence the information poorly or overlook important information altogether. Paths reduce the user's confusion and the required level of effort because they follow predetermined sequences that narrow choices.

Virtual guided tours are analogous to tours of physical places. Within a hypertext system, users can peek at the informational contents without exploring them in depth. Designers can customize guided tours for users with different levels of experience or knowledge. Studies suggest that more advanced users will not need a guided tour. Designers should, therefore, allow users to exit guided tours at any time.

Further readings

Baecker, R. M., Grudin, J., Buxton, W. A. & Greenberg, S. (1995). Hypertext and multimedia. In R.M. Baecker, J. Grudin, W.A. Buxton, & S. Greenberg (Eds.), Readings in human-computer interaction: Toward the year 2000. San Francisco, CA: Morgan Kaufmann Publishers, Inc.

Balasubramanian, V. (December, 1993). State of the art review on hypermedia issues and applications (chapters 4 & 9). Internet: http://www.isg.sfu.ca/~duchier/misc/hypertext_review/

Jonassen, D. H., & Grabinger, R. S. (1989). Problems and issues in designing hypertext/hypermedia for learning. In David H. Jonassen & Heinz Mandl (Eds.), Designing hypermedia for learning. NATO ASI Series F: Computer and systems sciences, 67, 3-26.

Marchionini, G., & Shneiderman, B. (1988). Findings facts vs. browsing knowledge in hypertext systems. IEEE Computer, (January, 1988), 70-80.

2.2.7 Give users menus and maps that outline their choices

To help users figure out their navigational options, provide graphical and text menus near the top of hypertext pages that outline users' opportunities for movement within a given web page or hypertext system.

Users of hypertext report that a major problem is that they tend to feel "lost" or "disoriented" in cyberspace. This condition occurs when users do not know:

- where they are in the hypertext system;
- where they have already been (nodes visited); and
- where they can explore (options for movement).

Web design experts recommend providing redundant navigational menus that offer identical text-based and icon-based options, since the translation will help users decode icon meanings and understand their own options for movement.

Make icon-based menus easy for users to locate, learn, remember, and use. Use clear button shapes and graphical representations that accurately illustrate what they do or are linked to. Navigational icon-buttons should appear three-dimensional so they look like something to push or click on.

There are several standard icon buttons in hypertext systems that convey direction. These icon buttons and their links are ordinary and predictable. They are generally labeled "next," "previous," "back," "up," and "help," and contain appropriate graphics (left arrow for previous, right arrow for next, etc.). Because such buttons function consistently, users tend to learn them quickly.

Make text-based menus apparent. On the web, text-based menus are often positioned directly under icon-based menus. Provide a designation that invites interaction and distinguishes the menu words from ordinary text on a page. This is generally done by separating the menu functions by vertical bars (generally pipe (|) or bracket ([ ) symbols). Text-based menus that follow this guideline can be interpreted by special screen-reading applications used by persons with disabilities.

Position critical icon-based and text-based navigation menus at the top of a web page. This allows users to see their navigational choices up-front, and enables them to continuously refer back to the menu to navigate through the rest of the hypertext space.

The position of navigational menus is very important because studies show that many users don't use the scroll bar. For this reason, you should put navigational menus at the bottom of hypertext pages as well as the top, to help users navigate without forcing them to scroll to the top of the page.

Caveat

Beware icon menus composed solely of graphics, as there are very few icons that are unmistakably understood across all computer interfaces and international borders. Text-labeled buttons are often essential to clearly indicate the function of a button.

Avoid "return to" or "back" buttons or links because you cannot predict where someone came from in cyberspace . Describe the destination of the link in absolute terms if possible, rather than with implied destinations.

Users need feedback to reassure them that their menu request, or click, is being processed.

Further readings

Apple Computer, Inc. (1989). HyperCard stack design guidelines. Menlo Park, CA: Addison-Wesley Publishing Company.

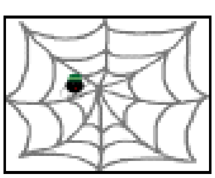
Horton, W. (1996). Designing and writing online documentation: Hypermedia for self-supporting products. New York: John Wiley & Sons, Inc.

Levine, R. (1996). Sun guide to web style. Sun Microsystems, Inc. Internet: http://www.sun.com/styleguide/tables/Welcome.html

Marchionini, G., & Shniederman, B. (1988). Findings facts vs. browsing knowledge in hypertext systems. IEEE Computer, (January, 1988), 70-80.

Nielsen, J. (1996a). Usability testing of WWW designs. Sun on the Net: User Interface Design. Internet: http://www.sun.com/sun-on-net/uidesign/usabilitytest.html

Nielsen, J. (1996b). Top ten mistakes in web design. What's Happening... Columns and commentary. Internet: http://www.sun.com/columns/alertbox/9605.html



To see a multimedia example that illustrates this principle, point your web browser to:

http://clipt.sdsu.edu/posit/ex/0020.html

2.2.8 Provide maps, diagrams to help users navigate

Provide graphical cues such as maps and overview diagrams to assist users with on-line navigation. The cues should orient users to their current location in the overall hypertext system and help them understand its structure.

In providing navigational maps and diagrams, you will help solve one of users' major problems with cyberspace—their tendency to feel "lost" or "disoriented." This condition occurs when users do not know:

- where they are in the hypertext system;
- where they have already been (nodes visited); and
- where they can explore (options for movement).

When people are lost in physical space, they often look for visual cues, such as a map, to help them identify their current location. You can extend the map concept to the hypertext world to help users with on-line navigation.

Graphical maps orient users by providing two-dimensional spatial displays of the hypertext network. Overview maps show how the major topics are organized—the content—and help users build their own cognitive maps of relationships between nodes. These cognitive maps, which are mental representations of the environment, may help users identify where they can go from their current location.

Provide graphical maps at both global and local levels. Global maps indicate the size of a hypertext network, while local maps present fine-grain details of a specific neighborhood.

Designers should also use maps or graphical representations to convey the structure of the hypertext system to the user.

Further readings

Balasubramanian, V. (December, 1993). State of the art review on hypermedia issues and applications (chapters 4 & 9). Internet: http://www.isg.sfu.ca/~duchier/misc/hypertext_review/

Edwards, D. M. & Hardman, L. (1989). 'Lost in Hyperspace': Cognitive mapping and navigation in a hypertext environment. In Ray McAleese (Ed.), Hypertext theory into practice. NJ: Ablex Publishing.

Levine, R. (1996). Sun guide to web style. Sun Microsystems, Inc. Internet: http://www.sun.com/styleguide/tables/Welcome.html

Nielsen, J. (1990). The art of navigating through hypertext. Communications of the ACM, 33(3), 296-310.

Thuring, M., Hannemann, J., & Haake, J. M. (1995). Hypermedia and cognition: Designing for comprehension. Communications of the ACM, 38(8), 57-66.

Yang, C., & Moore, D.M. (1995). Designing hypermedia systems for instruction. Journal of Educational Technology Systems, 24(1), 3-30.

2.2.9 Use web browsers that let users backtrack

Web browsers can make a difference in whether users of a system feel “lost” or “disoriented” in cyberspace. Use a browser that allows users to backtrack through previously visited nodes, or pages.

A backtrack feature helps users avoid this confusion by showing them a list of the titles of the pages (“nodes”) they have already visited. This helps users figure out how they got to their current location and think about where they want to go next in the hypertext space. This list of titles (a “history”) is usually displayed under the “Go” menu option. The titles of the pages are generally listed in reverse order: The title of the first page visited appears at the bottom of the list, while the title of the most recent page visited appears at the top of the list.

Researchers suggest that backtracking through history lists allows users to rapidly retrace their steps through a hypertext space. It also helps users escape difficult situations. Backtracking may be especially important for novice users. Experts recommend that the backtracking feature be available to users throughout a program and always activated the same way.

Further readings

Baecker, R. M., Grudin, J., Buxton, W. A. & Greenberg, S. (1995). Hypertext and multimedia. In R.M. Baecker, J. Grudin, W.A. Buxton, & S. Greenberg (Eds.), Readings in human-computer interaction: Toward the year 2000. San Francisco, CA: Morgan Kaufmann Publishers, Inc.

Balasubramanian, V. (December, 1993). State of the art review on hypermedia issues and applications (chapters 4 & 9). Internet: http://www.isg.sfu.ca/~duchier/misc/hypertext_review/

Horton, W. (1996). Designing and writing online documentation: hypermedia for self-supporting products. New York: John Wiley & Sons, Inc.

Nielsen, J. (1990). The art of navigating through hypertext. Communications of the ACM, 33 (3), 296-310.

2.2.10 Provide an index

Users of hypertext systems often feel “lost” or “disoriented” in cyberspace. To assist users with on-line navigation, designers should provide an index.

An index is usually an alphabetical list of topics that helps users find desired information and determine opportunities for movement within a hypertext system like a web site. Good indexes help users avoid getting lost in large documents.

Indexes should be built from the user’s point of view. Literate users are generally familiar with indexes contained in printed books; thus, hypertext indexes should be organized similarly (alphabetically), with links to multiple entries. The index can be built by hand or automatically. Index entries may come from titles, a keyword list, the page content, or a combination.

Caveat

Studies have shown that index users can find information about specific topics within hypertext systems but don’t accurately understand the relationships between topics. Therefore, designers should not provide an index if users must understand the organization and relationship between topics within a particular area, such as on a particular web page.

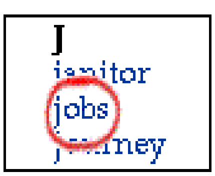
Further readings

Berners-Lee, T. (1995). Style guide for online hypertext. Internet: http://www.w3.org/hypertext/WWW/Provider/Style/All.html

Edwards, D. M. & Hardman, L. (1989). ‘Lost in Hyperspace’: Cognitive mapping and navigation in a hypertext environment. In R. McAleese (Ed.), Hypertext theory into practice. NJ: Ablex Publishing.

Horton, W. (1996). Designing and writing online documentation: hypermedia for self-supporting products. New York: John Wiley & Sons, Inc.

Marchionini, G., & Shneiderman, B. (1988). Findings facts vs. browsing knowledge in hypertext systems. IEEE Computer, (January, 1988). 70-80.



To see a multimedia example that illustrates this principle, point your web browser to:

http://clipt.sdsu.edu/posit/ex/0023.html

2.2.11 Provide a table of contents

To assist users with on-line navigation, designers should provide a table of contents that is hierarchical in nature. A table of contents shows users how the hypertext system is structured and how topics are organized.

Tables of contents, which contain lists of topics grouped in logical categories, help hypertext users avoid the common problem of becoming "lost" or "disoriented" in cyberspace. They enable users to view the topics and sub-topics and determine the relationships. This helps users understand what is available and decide on a plan for further exploration. Designers should link each entry of the table of contents to its respective section, so users quickly access quickly the information they want.

Further readings

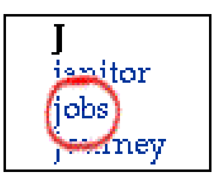
Baecker, R. M., Grudin, J., Buxton, W. A. & Greenberg, S. (1995). Hypertext and multimedia. In R.M. Baecker, J. Grudin, W.A. Buxton, & S. Greenberg (Eds.), Readings in human-computer interaction: Toward the year 2000. San Francisco, CA: Morgan Kaufmann Publishers, Inc.

Horton, W. (1996). Designing and writing online documentation: hypermedia for self-supporting products. New York: John Wiley & Sons, Inc.

Levine, R. (1996). Guide to web wtyle. Sun Microsystems, Inc. Internet: http://www.sun.com/styleguide/tables/Navigation.html

Lynch, P. J. (1995). Web style manual [on-line]. Yale Center for Advanced Instructional Media. Internet: http://info.med.yale.edu/caim/StyleManual_Top.HTML

Rivlin, E., Botafogo, R., & Shneiderman, B. (1994). Navigating in hyperspace: Designing a structure-based toolbox. Communications of the ACM, 37(2), 87-96.



To see a multimedia example that illustrates this principle, point your web browser to:

http://clipt.sdsu.edu/posit/ex/0023.html

2.2.12 Use headers, footers to tell users where they are

To help users navigate, include basic elements in the header and footer of a web page that tell users their location in a given document and in the overall hypertext system, or web site.

Users generally feel lost or disoriented in cyberspace when they do not know:

- where they are in a hypertext system;
- where they have already been (nodes visited); and
- where they can explore (options for movement).

To feel oriented, hypertext users need to understand the overall structure of the web site. They also should keep track of their movements within the structure. If the hypertext system doesn't provide external orientation cues, the user may have to remember a lot of information. To reduce mental strain, experts recommend breaking hypertext pages into three sections: a header, a footer, and a main content area.

The following are guidelines for designing headers:

1. Each web page should have a descriptive HTML title tag.

Titles are especially important in on-line documents, because users must frequently select a particular topic from a list of titles. Many web browsers record the titles of pages that have been visited on a history list, which users can find through a menu. With this in mind, you should craft a unique, concise title for each page in a given web site. The title should summarize the content of the page and be easily understandable. Put the most important words at the front of the title, as front-loaded titles can usually be scanned with a vertical eye movement.

2. Use a text-based header and graphical banner.

The organization of hypertext pages should be obvious. Pages should carry the summarized topic in the title, and long, multi-part documents should include page and subsection headings. By consistently placing a title and one or more hypertext links in the header area of the page, you help the user to see the main point of the document immediately. You will also enable users to move quickly on to other related material, or to a main menu or home page.

Further readings

Horton, W. (1996). Designing and writing online documentation: hypermedia for self-supporting products. New York: John Wiley & Sons, Inc.

Kahn, P. (1995). Visual cues for local and global coherence in the WWW. Communications of the ACM, 38(8), 67-69.

Levine, R. (1996). Sun guide to web style. Sun Microsystems, Inc. Internet: http://www.sun.com/styleguide/tables/Welcome.html.

Lynch, P.J. (1995). Web style manual. Yale Center for Advanced Instructional Media. Internet: http://info.med.yale.edu/caim/StyleManual_Top.HTML

Nielsen, J. (1990). The art of navigating through hypertext. Communications of the ACM, 33(3), 296-310.

2.2.13 Provide embedded hypertext links

On-line hypertext systems help users navigate by providing embedded links that connect users to other sections of the same document or other documents entirely.

Hypertext users report that one of the their main problems is that they tend to feel “lost” or “disoriented” in cyberspace. Embedded hypertext links help reduce navigational problems by showing users their options for movement. Embedded links, unlike explicit menus such as tables of contents, allow users to select a word or item embedded within the text of a page. They are selected with a touch screen cursor or mouse pointer.

In a hypertext system, any idea can be linked through hypertext to references providing more detailed information on that idea. Embedded menus or links may highlight semantic relationships between documents and ideas. They may also imply hierarchical relationships or other organizational information.

Hypertext links should be descriptive, conveying either the semantic or organizational relationship. Such links will help users build mental images of the organization of the hypertext system. The links also should be contextualized, telling something about their destinations. A de-contextualized link might read “Click **here** for more information,” where “here” is the hypertext link that sends the user to a destination known as “here.” De-contextualized links do not convey the nature of the link to the users; they can interfere with the user’s mental picture of the hypertext structure and organization.

Avoid links to documents that are dead ends. Documents have dead ends if they have no links or opportunities for movement. If the links only flow downward from the top level through chains of linked documents, most paths will become dead ends. To avoid this, designers should put a link on every page to the top level page of the hypertext system, as well as to a navigational menu. All links should be bi-directional, so users can easily travel in either direction, such as to or from a particular web site.

If you are designing hypertext for the Internet, you should use hypertext links to provide background information tailored to less knowledgeable users, since you can’t predict how knowledgeable hypertext users will be of the subject matter.

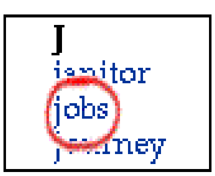
Further readings

Balasubramanian, V. (1993, December). State of the art review on hypermedia issues and application, chapters 4 and 9 [on-line]. Internet: http://www.isg.sfu.ca/~duchier/misc/hypertext_review/.

Jonassen, D.H., & Grabinger, R.S. (1989). Problems and issues in designing hypertext/hypermedia for learning. In Jonassen & Mandl (Eds.), Designing hypermedia for learning. NATO ASI Series F: Computer and Systems Sciences, 67, 3-26.

Kahn, P. (1995). Visual cues for local and global coherence in the WWW. Communications of the ACM, 38(8), 67-69.

Marchionini, G., & Shniederman, B. (1988). Findings facts vs. browsing knowledge in hypertext systems. IEEE Computer, (January, 1988), 70-80.



To see a multimedia example that illustrates this principle, point your web browser to:

http://clipt.sdsu.edu/posit/ex/0023.html

3. Readability

Reading in computing environments is a dynamic, interactive experience. For designers, the challenge is to balance readers' needs with content considerations. This section helps you build **readability** into the system, so customers concentrate on content, not computer rules. Design a system interface with an obvious structure, consistent layout, and familiar settings. Use color, cueing devices and headings to attract and direct readers' attention. Give learners enough information to tie new knowledge into old, and present text in small chunks to avoid memory overload. Write simple, affirmative sentences using the active voice. Help learners understand the content by supporting and clarifying ideas with quotes, questions and illustrations.

3.1 Improve readability by designing effective page and screen layouts

3.1.1 Don't overload users' working memory

Scrolling or clicking between screen pages differs from turning pages in a book. Book readers can view two pages of a book at a time. Computer users, however, must make one screen literally disappear from sight to view the next screen.

For this reason, a computer program puts a bigger burden on a reader's working memory than a printed book. This fact has significant design implications for those creating computer-based educational and informational programs.

When a user leaves one screen to access reference material on another screen, he/she must remember the information on the first screen while accessing the reference material on the second screen. This additional demand on cognitive resources can be frustrating. To avoid forcing the user to jump between screens, the designer should present the reference material more than one time if the information is needed on later screens. Text and illustrations should be repeated as needed for reference on later screens. The repetition may increase the size of the overall program, but will enable the viewer to proceed through the program without interruption, thereby making it more effective for the user.

If space is at a premium, you can create windows that can be opened when the reference is needed. A pop-up or pull-down window only takes up space when it is needed; therefore, the overall number of screens does not need to be increased. When designing pop-up or pull-down windows, keep in mind that:

- Each window should provide a different perspective, application, or function.
- The perspective or function of each window should be clearly labeled in the window title or by some consistent means.
- Limit the number of windows that may be opened at one time.
- Be consistent in the structure, location, and type of windows that are available to the user.
- Do not use overlapping windows in your displays.

Caveat

Designers may not want to use this principle if their goal is to help the user develop skills in accessing documents.

Further readings

Boling, E. (1994, September). Meeting the challenge of the electronic page: Extending instructional design skills. Educational Technology, pp. 13-18.

Jonassen, D.H. (1989). Functions, applications, and design guidelines for multiple window environments. Computers in Human Behavior, 5, 185-194.

3.1.2 Give your layout an obvious structure

When presenting textual information, use format design variables to create an organized layout with an obvious structure.

Format design variables include headings, line length, leading, paragraph denotation, justification, running heads, typeface, type size, and typographic cues. Each of these variables individually can help readers understand, remember, search for, or retrieve information. In combination, these variables form a structure for representing the content.

The format design variables control the customer's attention, and efficiently lead the customer through the material. A well-organized display helps the customer understand the new information and connect it to previous knowledge about the topic. This enhances learning.

Here are some tips for using format design variables to create screen layouts:

- Use headings systematically to assist the customer in searching for, retrieving, and comprehending the information. Headings evoke appropriate content schemata. The repeated use of headings keeps the schemata activated in the customer's short-term memory.
- Use vertical spacing systematically to help the customer understand the structure of the text.
- Use typographic cueing to direct the customer's attention and to express the structure of the material.

Caveat

Designers may not want to predetermine the structure of the content for some types of exploratory problem-solving activities. Structured formatting usually identifies the meaningful aspects of the material for the customer.

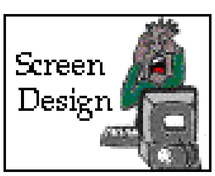
In some cases, designers may want to let users identify the most meaningful aspects of material on their own.

Further readings

Grabinger, R.S., & Amedeo, D. (1988). CRT text layout: perception of viewers. Computers in Human Behavior, 4, 189-205.

Grabinger, R.S. (1989). Screen layout design: research into the overall appearance of the screen. Computers in Human Behavior, 5, 175-183.

Hannafin, M.J., & Hooper, S.R. (1993). Learning principles. In M. Fleming & W.H. Levie (Eds.), Instructional message design: Principles from the behavioral and cognitive sciences. Englewood Cliffs, NJ: Educational Technology Publications.



To see a multimedia example that illustrates this principle, point your web browser to:

http://clipt.sdsu.edu/posit/ex/0025.html

3.1.3 Use a layout grid for consistency in design

Use a layout grid to provide a consistent look and function to every screen display in a program.

A layout grid is a set of horizontal and vertical lines that define margins, columns, and spaces. Well designed grids provide a sense of unity to the whole program, and a sense of continuity across many screen pages. When there is consistency between each screen display, the customer will feel more comfortable with the program. The amount of effort needed by the customer is reduced, as she/he knows what to expect and how to access the content. This can help the customer learn. Well designed displays also motivate and engage the customer.

Layout grids should be integrated into the various aspects of interface design. In addition to the basic screen page, researchers recommend that pop-up windows be consistent in their structure and location on the screen; the same is true of menu bars and navigational aids which form a significant part of the display. Other features that can benefit from a layout grid include animated sequences, moveable screen elements, and user interactivity.

Further readings

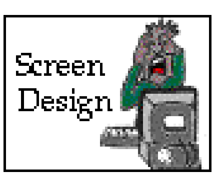
Hannafin, M.J., & Hooper, S.R. (1993). Learning principles. In M. Fleming and W.H. Levie (Eds.), Instructional message design: principles from the behavioral and cognitive sciences. Englewood Cliffs, NJ: Educational Technology Publications.

Hurlburt, A. (1978). The grid. New York, NY: Van Nostrand Reinhold Company.

Jonassen, D. H. (1989). Functions, applications, and design guidelines for multiple window environments. Computers in Human Behavior, 5, 185-194.

Marcus, A. (1992). Graphic design for electronic documents and user interfaces. New York, NY: ACM Press

Swann, A. (1989). How to understand and use grids. Cincinnati, OH: North Light Books.



To see a multimedia example that illustrates this principle, point your web browser to:

http://clipt.sdsu.edu/posit/ex/0025.html

3.1.4 Divide text into logical ‘chunks’

Organize textual material into logical and conceptual “screenfuls” that take into account the size of the screen and the limitations of the user’s working memory.

The goal should be to enable computer users to access and process a whole “chunk” of information before moving to another screen. When text flows from one screen to another without being organized into conceptual units, the presentation appears choppy, making it more difficult to understand. The user is forced to hold part of an idea in working memory while moving from screen to screen. In contrast, by designing text into screenfuls, each screen becomes a discrete unit. Users can proceed to the next new screen with fewer demands on working memory. Chunking also makes it easier for users to search for and retrieve information.

In general, designers determine chunk size based on the complexity, familiarity, and conceptual overlap of the content. The technique of chunking has received criticism when the chunks were too small. Another potential problem is that some content may not be adaptable to small screen chunks. Small chunks may break up the content in a way that fails to represent relationships between the chunks.

Writing text to fit into screen chunks requires concise writing skills. Outlines, lists, and numbered steps written in the imperative voice can help to condense the text. Designers can also use windows to display quick reference information to avoid taking up permanent space.

Further readings

Aspillaga, A. (1991). Implications of screen design upon learning. Educational Technology Systems, 20(1), 53-58.

Boling, E. (1994). Meeting the challenge of the electronic page: extending instructional design skills. Educational Technology, 20(9), 13-18.

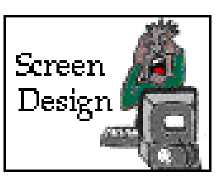
Grabinger, R.S., & Amedeo, D. (1988). CRT text layout: Perception of viewers. Computers in Human Behavior, 4, 189-205.

Grabinger, R.S. (1989). Screen layout design: Research into the overall appearance of the screen. Computers in Human Behavior, 5, 175-183.

Hannafin, M.J., & Hooper, S.R. (1993). Learning principles. In M. Fleming & W.H. Levie (Eds.), Instructional message design: Principles from the behavioral and cognitive sciences. Englewood Cliffs, NJ: Educational Technology Publications.

Hartley, J. (1987). Designing electronic text: The role of print-based research. Educational Communications & Technology Journal, 35(1), 3-17.

Winn, W. (1993). Perception principles. In M. Fleming & W. H. Levie (Eds.), Instructional message design: principles from the behavioral and cognitive sciences. Englewood Cliffs, NJ: Educational Technology Publications.



To see a multimedia example that illustrates this principle, point your web browser to:

http://clipt.sdsu.edu/posit/ex/0025.html

3.1.5 Orient users with a 'running head' on screens and windows

To keep a customer oriented to her or his location within a program, put a "running head" on screens and windows. Running heads inform the user of the name of the document they are working in and their location within it.

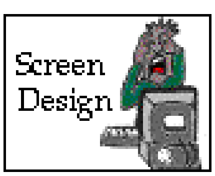
Electronic documents differ from printed materials in that they often do not provide familiar clues to the user as to location within the presentation. When reading a book, you can see at a glance whether you're at the beginning, the middle, or the end. In an electronic environment, the screen pages literally disappear once the user has finished viewing them. A user can not fold down a page or mark a place with a finger while searching elsewhere in the document. It is also difficult for users to refer back to the title of a current section or to flip ahead to see how much of the presentation remains before the end of the chapter.

Running heads are roughly equivalent to headers and footers in a printed book. Researchers suggest that it is important to let the user know how many screens are linked to the current one, and where the current screen fits within the sequence. When multiple windows are used, designers should title each window to distinguish its contents.

Further readings

Boling, E. (1994). Meeting the challenge of the electronic page: Extending instructional design skills. Educational Technology, (September 1994), 13-18.

Grabinger, R.S., & Amedeo, D. (1988). CRT text layout: perception of viewers. Computers in Human Behavior, 4, 189-205.



To see a multimedia example that illustrates this principle, point your web browser to:

http://clipt.sdsu.edu/posit/ex/0025.html

3.1.6 Economize space by providing ‘hidden content’

To maximize available screen display space, designers should display reference and support information only when needed, as “hidden content” accessed through windows, layers, or menus.

Since the relatively small display area is a major constraint in screen design, designers must look for content material that is not needed by all users or may only be needed briefly. Rather than devoting permanent screen space to this information, you can incorporate it as “hidden content” that can be accessed through a window or pull-down menu.

Hidden content is displayed only when the users activate it. For example, customers may access an in-depth description or a graphic representation by clicking on a specified object. A new window containing the previously hidden content would appear on the screen, overlapping the text or other screen elements. After accessing this content, the user closes the window and continues going through the program. This technique is particularly valuable when reference material will be accessed repeatedly.

Pull-down menus serve a similar function. They provide additional information or resources only when activated, making screen space available for other content. Help screens are the most common example of a menu-accessed window.

Designers should consider which types of content are suitable for display in a temporal window or pull-down window. Depending upon the program’s objectives, suitable content may include: reference material, repeated information, reminders, reviews, more in-depth information, extra resources, or information that addresses a specific population of users.

“Hidden content” window and menu design should follow regular screen and interface design guidelines including:

- Provide a different perspective, application, or function in each window.
- Clearly label each window’s perspective or function in the window title or by some other consistent means.
- Limit the number of windows that may be opened at one time.
- Be consistent in the structure, location, and type of windows that are available to the user.
- Do not use overlapping windows in displays.

Caveat

Designers should avoid using window displays if their audience would have difficulty in understanding their use, or may be confused by them.

Further readings

Boling, E. (1994, September). Meeting the challenge of the electronic page: extending instructional design skills. Educational Technology, pp. 13-18.

Hartley, J. (1987). Designing electronic text: The role of print-based research. Educational Communications & Technology Journal, 35(1), 3-17.

Jonassen, D. H. (1989). Functions, applications, and design guidelines for multiple window environments. Computers in Human Behavior, 5, 185-194.

Morrison, G.R., Ross, S.M., O'Dell, J.K., & Schultz, C.W. (1988). Adapting text presentations to media attributes: getting more out of less in CBI. Computers in Human Behavior, 4, 65-75.

3.1.7 Use color to enhance cognitive processing

Use color to help structure the content of computer displays and guide a customer through these displays. Researchers suggest using color to:

- enhance the “personality” of the different functional areas,
- distinguish between different types of information,
- establish a link between related pieces of information,
- highlight important or critical messages, and
- help customers understand complex displays.

Color can be used to direct a customer’s attention and to highlight significant content. When a color contrasts with surrounding elements, it will gain the customer’s attention and can be used to direct the customer through the material. Studies suggest that color can aid in learning and in searching through electronic text.

Color can also be used to create structure. Color gives prominence to, and creates relationships between, content areas. Color helps produce a hierarchy among highlighted, neutral, and low-lighted areas. One color or color scheme can link related windows, screens, or screen elements. Designers also use color to distinguish between different types of information or functional areas of the screen. This helps establish consistency and familiarity for the customer. For example, he/she can count on the blue windows always providing background data.

Designers should be aware that there are potential disadvantages to using color. Approximately 8 percent of males are at least partially color blind. In addition, overuse of color can clutter a screen and create confusion. Experts offer these guidelines for using color in computer programs:

1. Use a maximum of five plus or minus two colors.
2. Use foveal (central) and peripheral colors appropriately.
3. Use familiar, consistent color codings with appropriate references.
4. Use the same color for grouping related elements.

5. Use the same color code for training, testing, application, and publication.
6. Use high-value, high-chroma colors to attract attention.
7. Use redundant coding of shape, as well as color, if possible.
8. Use color to enhance black-and-white information.

Further readings

Hartley, J. (1987). Designing electronic text: The role of print-based research. Educational Communications & Technology Journal, 35(1), 3-17.

Humes, A. (1984). Designing text for information processing. ERIC Document: ED249940.

Marcus, A. (1992). Graphic design for electronic documents and user interfaces. New York, NY: ACM Press

Muter, P. (1996). Interface design and optimization of reading of continuous text. In H. van Oostendorp & S. de Mul (Eds.), Cognitive aspects of electronic text processing. Norwood, NJ: Ablex.

To see a multimedia example that illustrates this principle, point your web browser to:

http://clipt.sdsu.edu/posit/ex/0027.html

3.1.8 Use typographic cueing devices to direct the user's attention

Typographical cueing devices—such as boldface and color—help users assess the importance of the information they see and use this knowledge to understand the material.

The text within a presentation is not a uniform structure in which all ideas have equal importance. The ideas are often hierarchical, containing central and subordinate elements.

Highlighting techniques (or directive cues), such as boldface, color, or underlining, draw the reader's attention to specific parts of the text. This directs and guides the reader through the material.

Labeling techniques, such as headings, marginal notes, or content markers, give structure and organization to the material. They also present a macrostructure to the text, an overall view which helps the reader to understand the content and to integrate new material with existing knowledge.

Computers allow designers to use some typographic cues that are not available for printed material. These include inverse lettering, flashing, movement, animation, and hypertext. Additionally, color is available without the extra costs required for printed material.

Designers should know how to use typographic cues effectively. The human eye is sensitive to changes in stimuli. Thus, boldface type set within a paragraph, or a marginal note set off by itself, will stand in contrast to the rest of the display and draw attention. However, a display may contain many contrasting or changing elements, and designers must control these competing factors. When highlighting text, it is preferable to contrast in one dimension. For example, designers might want to add either boldness, italics, or color, but should be cautious about combining these properties.

You may want to group typographic cues to provide global access or local access. Global access includes content lists, concept diagrams, indices, and glossaries. Local access includes headings, selected highlighting, marginal notes, terminology markers, and content markers.

Here are some suggestions for using typographic cues:

- Use cues only when their purposes are perfectly clear. If a purpose is not clear, explain it.

- Use a cue sparingly. Effectiveness decreases as frequency increases.
- Avoid complicated cues.

Caveat

Designers may not want to predetermine the structure of the content for some types of exploratory or generative problem-solving activities. Structured formatting usually identifies the meaningful aspects of the material for the customer. In some cases, designers may want to apply a constructivist approach with generative processes that would allow the user to create his or her own meaningfulness to the material.

Further readings

Hartley, J., & Jonassen, D.H. (1985). The role of headings in printed and electronic text. In Jonassen, D.H. (Ed.) The technology of text Volume II: Principles For structuring, designing, and displaying Text. Englewood Cliffs, NJ: Educational Technology Publications.

Humes, A. (1984). Designing text for information processing. ERIC Document: ED249940.

Muter, P. (1996). Interface design and optimization of reading of continuous text. In H. van Oostendorp & S. de Mul (Eds.), Cognitive aspects of electronic text processing. Norwood, NJ: Ablex.

Grabinger, R.S., & Amedeo, D. (1988). CRT text layout: perception of viewers. Computers in Human Behavior, 4, 189-205.

To see a multimedia example that illustrates this principle, point your web browser to:

http://clipt.sdsu.edu/posit/ex/0027.html

3.1.9 Direct the user’s attention by controlling change and contrast

Elements of the screen display that are perceptually conspicuous, or prominent, will stand out and get the user’s attention. Designers can carefully plan the layout of prominent elements on the screen to guide the user through the material.

Perceptual prominence is mainly created by change and contrast. Human perception is only sensitive to changes in stimulation. These changes must be significant enough for the brain to notice. The greater the degree of change, the more likely that it will be attended to. For example, an abrupt change from a light background to a dark background will be noticed, whereas a gradual change may be missed. A fast-paced animation sequence may command attention, whereas a directional arrow that moves slowly across the screen may not. A designer can control the user’s attention by varying the rate at which this change occurs.

Contrast is a subset of change, since a contrasting element creates a change. The use of contrast in screen design is one of the most powerful elements for controlling the attention of the user. Contrast comes in many forms, including size, shape, color, placement, content, brightness, motion, and modality, or structure. Contrast distinguishes between different parts of the screen and between different parts of the message. Designers must use some form of contrast to highlight important ideas in a message. Contrast must also be used in designing the screen layout. Contrast can be used to maximize differences; the lack of contrast can also be used to minimize differences. Elements that lack contrast will be perceived as part of a group, like the words in this paragraph.

Further readings

Gordon, S. (1994). Systematic training program design: Maximizing effectiveness and minimizing liability. Englewood Cliffs, NJ: PTR Prentice Hall.

Winn, W. (1993). Perception principles. In M. Fleming & W.H. Levie (Eds.), Instructional message design: Principles from the behavioral and cognitive sciences. Englewood Cliffs, NJ: Educational Technology Publications.

3.2 Give readers enough information

3.2.1 Use familiar descriptions, settings, and backgrounds

Use generic descriptions, settings, and backgrounds so the majority of readers will be familiar with the context. Also use generic backgrounds or locations for photos and videos. Don't use material associated with only one culture or ethnic group. Don't rely on local culture, pop culture, or nationalistic icons. Avoid using images that rely on jokes, figures of speech, slang, or other terminology that are well-known only within a particular subculture.

Readers need to be able to tie new information to old or previously learned information. If new information is presented in a context that is unfamiliar, readers will have difficulty interpreting the new information and integrating it into their schemata, or generic knowledge about events, scenarios, actions, or objects that they have acquired from past experience. Readers may misinterpret new material because they lack the appropriate prior knowledge to elicit the correct schema, or mental model.

In addition, if material from one culture or ethnic group is presented, individuals outside those groups may feel the information does not relate to them or is irrelevant. Studies also indicate that cultural schemata can influence how readers interpret written material, and that words often have different connotations in different cultures.

Further readings

Morical, K., & Tsai, B. (1992). Adapting training for other cultures. Training and Development, 46(4), 65-68.

Reynolds, R.E., Taylor, M.A, Steffensen, M.S., Shirey, L.L., & Anderson, R.C. (1982). Cultural schemata and reading comprehension. Reading Research Quarterly, 17(3), 353-366.

3.2.2 Provide quotes, questions, or photos to support the text

Provide accompanying material, such as quotes, questions, or photos, to increase the reader's understanding of and interest in the text. Studies suggest that supportive materials, such as pullout quotes and small photos, interspersed in the text will increase the reader's interest level. If a reader pays more attention, he/she is more likely to process the information into working memory and recall it later. Accompanying material that presents important ideas may also help the reader better understand key points.

Further readings

Sadoski, M., Goetz, E.T., & Fritz, J.B. (1993). Impact of concreteness on comprehensibility, interest, and memory for text: Implications for dual coding theory and text design. Journal of Educational Psychology, 85(2), 291-304.

Wanta, W., & Gao, D. (1994). Young readers and the newspaper: Information recall and perceived enjoyment, readability, and attractiveness. Journalism Quarterly, 71(4), 926-936

To see a multimedia example that illustrates this principle, point your web browser to:

http://clipt.sdsu.edu/posit/ex/0010.html

3.2.3 Use graphics and illustrations to supplement and support the text

Provide graphics, such as pictures, icons, and drawings to supplement and support the textual information. Graphics help readers recall previously learned information; in some situations, they can be easier for readers to process and recognize than words. In addition to clarifying the material, graphics help readers organize information and relate it to what they already know. Graphics are also a good way to avoid technical jargon.

Pictures should have captions and be clear and easy to identify. Pictures and text should support each other, and should be placed near each other.

Further readings

Hartley, J. (1978). Designing instructional text. New York: Nichols Publishing.

Pettersson, R. (1993). Comprehensibility. Paper presented at the International Symposium of the International Visual Literacy Association, Delphi, Greece. (ERIC Document Reproduction Service No. ED 365 299).

Wanta, W., & Gao, D. (1994). Young readers and the newspaper: Information recall and perceived enjoyment, readability, and attractiveness. Journalism Quarterly, 71(4), 926-936.

Wise, M.R. (1993). Using graphics in software documentation. Technical Communication, 40(4), 677-681.

To see a multimedia example that illustrates this principle, point your web browser to:

http://clipt.sdsu.edu/posit/ex/0010.html

3.3 Use words readers can easily understand

3.3.1 Use common vocabulary

Use familiar vocabulary that occurs frequently in everyday text. Readers will find it easier to read, process, and recall a passage if the words are familiar. Studies have shown that text with unfamiliar words is more difficult for readers to process and remember than text based on commonly used words.

If you're not sure whether you're writing clearly enough, you might use readability formulas to predict the difficulty of the text. Difficulty of text is measured by the difficulty of the vocabulary and the sentence length. Words that are unfamiliar are high in difficulty and thus reduce the readability of the text. There are over 100 predictive readability formulas available, including:

- **Readability Calculations**: Micro Power and Light Company, 1995 (software program).
- **The New Dale-Chall Readability Formula**: Chall, J.S. & Dale, E. (1995). Readability revisited: The new Dale-Chall readability formula. Cambridge, MA: Brookline Books.
- **Fry Readability Graph**: Fry, E. (1968). A readability formula that saves time. Journal of Reading, 11, 513-516, 575-578.

There are also many references available that list commonly known words. Some of the books and lists are:

- Ogden, C.K. (1974). The general basic English dictionary. London: Evans Brothers Limited.
- Johnson, D.D., Moe, A.J., & Baumann, J.F. (1983). The Ginn word book for teachers. Lexington, MA: Ginn and Company.
- Buckingham, B.R., & Dolch, E.W. (1936). A combined word list. Boston: Ginn and Company.

Caveat

Some researchers argue that substituting easier for harder words is not the only way to make text more readable. This process may even make the passage more difficult to read if it results in reduced cohesion between the words, sentences, and paragraphs. Factors often ignored by readability formulas are:

- if unfamiliar and technical terms are defined;
- if unfamiliar concepts are explained in terms of the reader's previous knowledge;
- if chapters and sections are well organized with the use of headings and questions to improve structure; and
- if illustrations containing captions are placed close to the text they support to explain difficult ideas.

Further readings

Britton, B.K., Glynn, M.J., Meyer, B.J.F., & Penland, M.J. (1982). Effects of text structure on use of cognitive capacity during reading. Journal of Educational Psychology, 74(1), 51-61.

Chall, J.S., & Dale, E. (1995). Readability revisited: The new Dale-Chall readability formula. Cambridge, MA: Brookline Books.

Hulme, C., Maughan, S., & Brown, G. (1991). Memory for familiar and unfamiliar words: Evidence for a long-term memory contribution to short-term memory span. Journal of Memory and Language, 30(6), 685-701.

Pettersson, R. (1993). Comprehensibility. Paper presented at the International Symposium of the International Visual Literacy Association, Delphi, Greece. (ERIC Document Reproduction Service No. ED 365 299).

3.3.2 Use concrete words, examples and sentences

Users find it easier to read and process concrete words and ideas rather than abstract ideas. Abstract words refer to intangibles, such as general ideas, qualities, conditions, acts, or relationships. In contrast, concrete words refer to real-world things, or classes of things. A poem is concrete; poetry is abstract.

Abstract words often result in more complex and obtuse writing; concrete words result in more direct writing that clearly identifies the agent and the action. Concrete words and concepts are easier to understand because they create mental images in the mind of the reader. Studies suggest that strong mental images can help a reader to recall and relate previously learned information—such as definitions—to the information he/she is currently reading.

Caveat

You should consider the context of material when deciding whether to use an abstract or a concrete word; in some cases, it may be more appropriate to use an abstract term. For example, the abstract term “assets” may be adequate within an annual report to refer to a company’s goods and properties, but concrete terms like “ten fax machines” and “two laptop computers” may be necessary within an inventory report to describe the company’s assets.

Further readings

Akin, C.E. (1994). Developmental trends in lexical decisions for abstract and concrete words. Reading Research Quarterly, 29(3), 251-261.

Brusaw, C. T., Alred, G.J., & Oliu, W.E. (1987). Handbook of technical writing. New York, NY: St. Martin’s Press, Inc.

Sadoski, M., Goetz, E.T., & Fritz, J.B. (1993). Impact of concreteness on comprehensibility, interest, and memory for text: Implications for dual coding theory and text design. Journal of Educational Psychology, 85(2), 291-304.

Schwanenflugel, P.J., Akin, C., & Luh, W.M. (1992). Context availability and the recall of abstract and concrete words. Memory and Cognition, 20(1), 96-104.

Shimoda, T.A. (1993). The effects of interesting examples and topic familiarity on text comprehension, attention, and reading speed. Journal of Experimental Education, 61(2), 93-103.

3.3.3 Avoid jargon, slang, and other unfamiliar words

Avoid using jargon, slang, local idioms, euphemisms, colloquial language, technical words, and buzz words unless the target audience is already familiar with the terms. Readers who are not familiar with the vocabulary in a passage will find it difficult to read, understand, and remember. In addition, specialized vocabularies are usually used within unique groups of people, such as job-related, ethnic, and cultural groups. Specialized vocabulary may alienate readers who are not part of the group who would normally use these terms.

To communicate clearly within a multicultural society, you must use language that is free of jargon, uncommon words, and culturally specific connotations. Studies suggest that cultural background can influence how readers interpret written material. Some words may have different connotations within different cultures, even if they use the same "dictionary" definitions.

Further readings

Brusaw, C. T., Alred, G.J., & Oliu, W.E. (1987). Handbook of technical writing. New York, NY: St. Martin's Press, Inc.

Clutterbuck, C. (1994). Grunts or jargon: Poor communication in educational writing. Paper presented at the Annual Meeting of the International Communication Association, Sydney, New South Wales, Australia. (ERIC Document Reproduction Service No. ED 373 328).

Morical, K. & Tsai, B. (1992). Adapting training for other cultures. Training and Development, 46(4), 65-68.

Reynolds, R.E., Taylor, M.A, Steffensen, M.S., Shirey, L.L., & Anderson, R.C. (1982). Cultural schemata and reading comprehension. Reading Research Quarterly, 17(3), 353- 366.

3.3.4 Avoid abbreviations, acronyms, and initialisms

Although abbreviations, acronyms, and initialisms may save space, you should avoid them unless you are certain that readers will know the terms for which they stand. Consider the level of knowledge and background of the readers. If there is doubt that the abbreviation will be known, don't use it. If an abbreviation must be used, make sure it follows the word for which it stands.

Abbreviations, acronyms, and initialisms can increase the level of difficulty of a passage, as readers easily forget their meaning. In addition, the extra effort needed to remember the meanings increases the effort needed to process and recall the textual information.

Further readings

Brusaw, C. T., Alred, G.J., & Oliu, W.E. (1987). Handbook of technical writing. New York, NY: St. Martin's Press, Inc.

Hartley, J. (1978). Designing instructional text. New York: Nichols Publishing Company.

3.4 Use sentences that readers can easily process and comprehend

3.4.1 Use simple sentences

When possible, use simple noun-verb-object sentences that present one idea. Avoid using compound sentences, as these increase the number of main ideas in a sentence. Sentences with too many ideas become dense; this makes reading the text more tedious. It is best to vary sentence length within a text to increase the ease of reading, but avoid sentences that are too long or too short.

Some researchers argue that shorter sentences can actually make the text more difficult, because the ideas are presented independently and lack cohesion; this may force the reader to make semantic connections. Authors should also be careful not to leave out important background information in their attempt to write shorter sentences; studies indicate this could reduce the reader's comprehension of the text.

Further readings

Botta, R. and others (1993). Does shorter mean easier to understand? A study of comprehension of USA Today information stories. Paper presented at the Annual Meeting of the Association for Education in Journalism and Mass Communication, Kansas City, MO. (ERIC Document Reproduction Service No. ED 361 678).

Britton, B.K., Glynn, M.J., Meyer, B.J.F., & Penland, M.J. (1982). Effects of text structure on use of cognitive capacity during reading. Journal of Educational Psychology, 74(1), 51-61.

Humes, A. (1984). Designing text for information processing. Technical report 86. Southwest Regional Laboratory for Educational Research and Development, Los Alamitos, CA (ERIC Document Reproduction Service No. ED 249 940)

Pettersson, R. (1993). Comprehensibility. Paper presented at the International Symposium of the International Visual Literacy Association, Delphi, Greece. (ERIC Document Reproduction Service No. ED 365 299).

3.4.2 Use affirmative statements rather than negative statements

Affirmative statements are easier to read than negative statements. This is particularly true when the statements contain multiple negatives. When a reader encounters a negative statement, she/he must process the content and then negate it. In contrast, affirmative statements directly state the content.

One exception to this principle may be when authors want to use negative qualifications in order to emphasize a concept. Sometimes use of a negative statement may present the concept more forcefully than an affirmative statement.

Further readings

Hartley, J. (1978). Designing instructional text. New York, NY: Nichols Publishing Company.

Humes, A. (1984). Designing text for information processing. Technical report 86. Southwest Regional Laboratory for Educational Research and Development, Los Alamitos, CA. (ERIC Document Reproduction Service No. ED 249 940).

Williams, J. M. (1990). Style: Toward clarity and grace. Chicago, IL: University of Chicago Press.

3.4.3 Use the active voice rather than the passive voice

In grammar, “voice” indicates the relation of the subject to the action of the verb within a sentence. When the verb is in the active voice, the subject acts.

The “home” button will return you to the introduction.

Using the active voice forces the author to name the specific agent of the action. The active voice is easier to read and process because sentences are usually more direct, contain fewer words, and parallel the subject-verb-object order of English.

In contrast, when the verb is written in the passive voice, the subject is acted upon. The passive voice reverses the direct order of the agent-action-goal and reduces the easy flow of the text.

You will be returned to the introduction by the “home” button.

Readers have greater difficulty understanding the passive voice because it tends to be wordy and indirect. However, writers can use the passive voice effectively under certain conditions. For example, writers may choose the passive voice when they want to avoid stating who is responsible for an action, because it is not known or not important.

Further readings

Brusaw, C.T., Alred, G.J., & Oliu, W.E. (1987). Handbook of technical writing. New York, NY: St. Martin’s Press.

Humes, A. (1984). Designing text for information processing. Technical report 86. Southwest Regional Laboratory for Educational Research and Development, Los Alamitos, CA (ERIC Document Reproduction Service No. ED 249 940)

Williams, J. M. (1990). Style: Toward clarity and grace. Chicago, IL: University of Chicago Press.

3.4.4 Break up strings of nouns

Readers have difficulty understanding strings of nouns, called stacked nouns, because the “function” words that show the relationships between the nouns—such as “of,” “to,” and “with”—are missing. Here’s an example of a sentence with “stacked nouns”:

> Use available local positions, job search, and career information decision systems to help customers think about possibilities.

With stacked nouns, the reader must infer what the function words are. This slows the reading process and increases the possibility for misinterpretation. To help the reader determine the relationships between nouns, break up strings of nouns by inserting the function words. What follows is a more understandable version of the previous example:

> Use available local positions in concert with job search information systems and career information decision systems to help customers think about possibilities.

Further readings

Humes, A. (1984). Designing text for information processing. Technical report 86. Southwest Regional Laboratory for Educational Research and Development, Los Alamitos, CA (ERIC Document Reproduction Service No. ED 249 940)

Murphy, G.L. (1990). Noun phrase interpretation and conceptual combination. Journal of Memory and Language, 29, 259-288.

3.5 Construct organized and coherent paragraphs

3.5.1 Use headings to present key ideas and provide structure

Headings can help readers recall, search, and retrieve information from the text. Headings also act as signaling devices, directing the readers' attention to important or key ideas. Headings also help readers understand the text structure, which stimulates learning and lets them search for information in a passage. Headings help readers avoid information overload.

By providing structure and key conceptual information, headings may help readers use meaningful reading strategies. Without this structure, readers may use a rote reading strategy in which the text is viewed as a list of separate items to be memorized. This rote-reading approach often results in readers remembering the first or last items in the passage but forgetting important conceptual ideas or inferences.

Studies indicate that headings are crucial for longer, expository documents. Researchers have studied whether headings phrased as questions or as statements are most effective; results indicated that both help readers, although each is more effective in different circumstances and with readers of different abilities. Further research is needed for conclusive findings. Other factors that may influence the effectiveness of headings include the wording of headings, the reader's prior knowledge, and the limitations of one and two word headings.

Further readings

Hartley, J., & Trueman, M. (1985). A research strategy for text designer: The role of headings. Instructional Science, 14(2), 99-155.

Lorch, R.F., Pugzles Lorch, E., & Inman, W.E. (1993). Effects of signaling topic structure on text recall. Journal of Educational Psychology, 85(2), 281-290.

Spyridakis, J.H., & Wenger, M.J. (1992). Writing for human performance: Relating reading research to document design. Technical Communication, Second Quarter, (2), 202-215.

4. Cultural adaptability

Cultural adaptability means creating work environments that meet needs of a multicultural population. But designing systems for universal access requires time, patience, and sensitivity. This section helps you create an environment that is both free of bias and respectful of differences between cultural groups. Guidelines on using signs, symbols and icons are presented, and cultural differences are discussed. You'll also find strategies for effective screen design. Sensitivity, respect, and enlightened design make customers comfortable in technical and physical environments.

4.1 Attend to cultural differences among users

4.1.1 Keep natural, cultural eye movements in mind

Think of a screen display as a maze through which you must guide the viewer.

The screen design shouldn't visually confuse the viewer. The various elements demanding attention should not work at cross-purposes. When the viewer is not certain what to pay attention to, he/she becomes less efficient and must unnecessarily use more effort. For example, placing an interesting graphic at the bottom of a screen display will conflict with the tendency to begin viewing at the top of the screen. The viewer will first be drawn to view the graphic at the bottom, then will have to shift attention to the top of the screen to continue.

Designers should understand people's fundamental screen viewing tendencies and use them advantageously. These tendencies are influenced by principles of perception and physiology, such as:

- The eye tends to follow lines and contours. The eye has specific sensors for detecting edges; consequently, we attend to edges quickly and easily. Screen elements that "line-up" will be attended to in sequence.
- Perceptually salient, or prominent, elements will draw attention. Saliency may be created by size, shape, color, placement on the screen, the modality or structure, or any method of creating contrast or change.
- Humans naturally use a horizontal-vertical frame of reference, but this may vary across cultures. Although screen designs based on a different frame of reference may appear interesting, they may be more difficult for a viewer to access.
- Literate viewers read screen displays in the same sequence and direction that they read text.

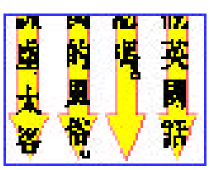
In addition to these natural tendencies, viewers' eye movements across a screen are partially determined by language. English readers proceed from left to right and then from top to bottom, while Hebrew readers proceed from right to left and then from bottom to top.

Designers may choose, in certain situations, to interrupt natural or cultural eye movements. For example, designers may want to create visually competing elements that require the viewer to chose a direction in order to encourage exploration or adventure. Designers may also use competing visual elements to slow down users, encouraging them to reflect.

Further readings

Gordon, S. (1994). Systematic training program design: Maximizing effectiveness and minimizing liability. Englewood Cliffs, NJ: PTR Prentice Hall.

Winn, W. (1993). Perception principles. In M. Fleming & W.H. Levie (Eds.), Instructional message design: Principles from the behavioral and cognitive sciences. Englewood Cliffs, NJ: Educational Technology Publications.



To see a multimedia example that illustrates this principle, point your web browser to:

http://clipt.sdsu.edu/posit/ex/0039.html

4.1.2 Avoid culture-centric biases

When designing systems for universal access, minimize the use of culturally-biased concepts, terminology, folklore, social norms, and graphic and auditory design features.

Reasoning processes and perceptions toward computing vary from culture to culture. Therefore, sensitivity must be used in developing interfaces for computer use in a multi-cultural environment.

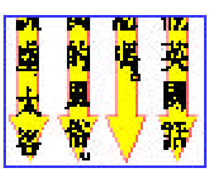
Likewise, reasoning processes and perceptions toward computing vary from culture to culture. Ideally, software designers should understand the target audience and its respective cultures.

When considering cross-cultural differences in human-computer interaction, consider the following:

- **Time perception.** Cultures have different attitudes towards patience, speed of response and service, and requirements that tasks be handled sequentially or in parallel.
- **Individualism vs. collective action.** Some cultures value intensive consultation between families and work groups, while others promote individual thought and action.
- **Power distance.** Cultures differ in the degree to which they accept authority structures that distribute power unequally.

Further readings

Watson, R. T., Ho, H. T., & Raman, K. S. (1994). Culture: A fourth dimension of group support systems. Communications of the ACM, 37 (10), 45-55.



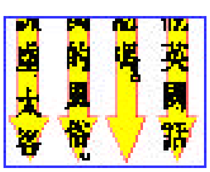
To see a multimedia example that illustrates this principle, point your web browser to:

http://clipt.sdsu.edu/posit/ex/0039.html

4.1.3 Avoid using culture-specific symbols

Symbols are based on social conventions and have little or no inherent meaning. They may not look anything like the objects, structures, or processes they represent. For example, the function of the "close-box widget" in a computer window is not immediately clear. Users must learn its function through instruction or by trial and error. Likewise, letters in the alphabet are arbitrary shapes that cannot be deduced from experiential knowledge.

Avoid using culture-specific symbols because people who are not familiar with the culture that uses these symbols will find them hard to interpret. For example, some computer programs use a steaming cup of coffee to tell the user that there will be a long wait. This might work in cultures where coffee is associated with taking a break, but might be misunderstood by others.



To see a multimedia example that illustrates this principle, point your web browser to:

http://clipt.sdsu.edu/posit/ex/0039.html

5. Advisement and coaching

No matter how well designed the computer environment, there are always customers who need advisement and coaching. Well-trained, alert, and helpful support personnel are vital to the success of any computer-based service system. This section offers suggestions about in-person and telephone consultations. Principles for helping customers to use the computer system are included because the success of support services will be strongly influenced by the competence and independence of customer-learners.

5.1 Promote customers' self-efficacy

5.1.1 Enhance learner self-efficacy

If your customers believe they can do something, you can bet that they'll try it.

Perceived self-efficacy, or belief that one will be able to perform a task successfully, is an important motivational factor. Learners who believe they will succeed are more likely to attempt an activity, persist despite obstacles, expend more effort and to attain a high level of mastery. Learners who attempt and persist at tasks are also more likely to develop greater self-efficacy than those who do not.

If you are helping customers who must use computers, one of your jobs will be to facilitate your customers' self-efficacy. Users who are hesitant to use electronic systems will not fulfill their informational and problem-solving needs. Computer novices with high self-efficacy are more likely to use the computer and to persist in their attempts.

A substantial body of research demonstrates significant relationships between perceived self-efficacy and achievement. Self-efficacy related interventions are most effective with low-achieving, low self-efficacy learners.

Self-efficacy is situation- and domain-specific. In other words, a person may believe she / he can successfully complete a drawing (high self-efficacy) and be equally certain he / she could never use a personal computer (low self-efficacy). These beliefs may or may not reflect the person's actual capabilities accurately; however, the belief itself will influence whether the person chooses to attempt either drawing or learning how to use computers effectively.

Further readings

Bandura, A. (1989). Human agency in social cognitive theory. American Psychologist, 44, 1175-1184.

Gist, M., Schwoerer, C. & Rosen, B. (1989). Effects of alternative training methods on self-efficacy and performance in computer software training. Journal of Applied Psychology, 74, 884-891.

Hill, T., Smith, N., & Mann, M. (1987). Role of efficacy expectations in predicting the decision to use advanced technologies: The case of computers. Journal of Applied Psychology, 72(2), 307-313.

5.2 Provide outstanding customer support

5.2.1 Be a people person

First and foremost, your customers are people. While it is necessary, even crucial, to have expertise in specific areas, your interpersonal skills will provide a human context for learning.

A substantial body of research supports the positive effects of skills like empathy and respect on relationships. Research originally focused on counseling and psychotherapy, but has expanded to include parent-child and helper-student relations.

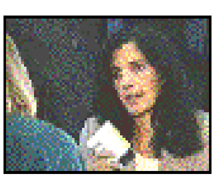
Helpers' interpersonal skills are key to learners' involvement and intellectual achievement. Learners who feel understood and respected tend to be more motivated and less anxious. Consequently, they learn more. They are more likely to take intellectual risks, such as asking questions. They are more likely to risk incorrect answers, or brave new academic or skill challenges. Learners who feel misunderstood or disrespected may withdraw from the learning situation.

Further readings

Carkhuff, R. (1969). Helping and human relations (Vols. 1-2). New York: Holt, Rinehart & Winston.

Ivey, A. and Authier, J. (1978). Microcounseling: Innovations in interviewing, counseling, psychotherapy and psychoeducation (2nd Ed.). Springfield, IL: Charles C. Thomas.

Rogers, C. (1983). Freedom to learn. Columbus, OH: Charles E. Merrill.



To see a multimedia example that illustrates this principle, point your web browser to:

http://clipt.sdsu.edu/posit/ex/0041.html

5.2.2 Establish a good working relationship with customers

Although the main ingredient in customer satisfaction is effective problem resolution, you can enhance customer satisfaction by fostering a good working relationship. To do this, you must respect and listen to the customer.

Respecting someone means valuing them as worthwhile. Don't look down on callers because they don't know things that seem obvious to you.

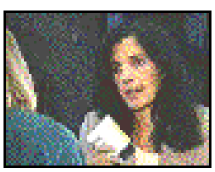
Active listening reduces the chance of miscommunication and creates a positive environment for a conversation. As the name implies, active listening requires the listener to work at understanding the speaker. To practice active listening:

- **Listen** carefully to what customers say.
- **Paraphrase** the main ideas you hear them say.
- Ask questions to **clarify** what they say. Make sure you both have a common understanding of key terms. If a customer's words seem vague, ask the customer to be more specific.
- Ask users for **feedback** to confirm whether you have understood them and to make corrections if you have not.

Further readings

Microsoft. (1995). Microsoft sourcebook for the help desk. Redomond, WA: Microsoft Press.

Muns, R. (1993). The help desk handbook. Colorado Springs, CO: The Help Desk Institute.



To see a multimedia example that illustrates this principle, point your web browser to:

http://clipt.sdsu.edu/posit/ex/0041.html

5.2.3 Give every customer special attention

Most people who phone for customer support are straightforward, reasonable, and polite. Some, of course, are difficult. While people aren't easily categorized into personality types, the types of problem interactions are more neatly categorized.

Here is some advice for dealing with different kinds of customers over the phone.

Low-tech customers

Some customers will know about computer systems from on-line or off-line orientation and training resources. If you get a call from a complete novice, your primary role will be to help the customer locate and access these resources.

By phone, let the customer know you cannot thoroughly review all the basic information about how to use the system. Find out what specifically the customer is trying to do, then refer the customer to appropriate tutorial material. Stay with the customer until she/he has found the necessary training resource and has begun using it.

Timid customers

Some people are intimidated by new technology. Establish a good working relationship with these customers, so that you can help them feel more comfortable. As they relax, they will let you know what they need.

Show respect, listen attentively, and offer periodic reassurances. Above all, avoid adding to the customer's nervousness; proceed slowly.

Non-stop talkers

You need to interrupt and provide focus for people who repeat themselves or digress frequently or at length. You should be assertive and firm and still be pleasant.

First, interrupt very explicitly, while letting the person know you are trying to help. Say something like, "I'm going to interrupt you here. I want to get a better idea of what your situation is, so I have some questions I need to ask you." If the person continues talking, interrupt again.

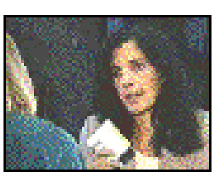
Get the information you need and provide focus by asking closed-ended questions, or questions that can only be answered by "yes" or "no." As soon as the customer replies, but before he / she elaborates, ask another question. Continue in this manner, firmly and pleasantly showing interest and keeping the conversation focused.

Further readings

Gallagher, R. (1995). Effective software customer support. New York: International Thomson Computer Press.

Microsoft. (1995). Microsoft sourcebook for the help desk. Redomond, WA: Microsoft Press.

Muns, R. (1993). The help desk handbook. Colorado Springs, CO: The Help Desk Institute.



To see a multimedia example that illustrates this principle, point your web browser to:

http: / / clipt.sdsu.edu / posit / ex / 0041.html

5.2.4 Provide 'distributed' customer support

All computer lab environments must provide technical and software application-related assistance to their customers. Some may have support personnel on-site, while others may not. All centers will have some questions they cannot handle on-site.

To best meet customers' needs, you should consider creating a virtual or physical customer-support network, which can provide distributed, or remote, customer support. This type of network can service customers as well as support staff.

Distributed customer-support should:

- Provide remote (telephone, e-mail, fax, etc.) advisement.
- Develop user orientation or training materials to encourage customer independence and minimize the need for face-to-face or remote advisement.
- Develop and maintain electronic and hard-copy support materials (i.e., job aids).
- Support and advise customer-support personnel.
- Analyze data to determine patterns of user problems.
- Develop and maintain a library of documentation for support personnel. This database should include software documentation, records of customer problems, and pointers to other resources (e.g., on-line mailing lists or other forums for obtaining information about software).
- Set up a skills database to identify specific technical expertise at various centers to facilitate routing of support problems that can't be handled at a local unit.
- Install new software and maintain up-to-date versions.
- Keep informed about technology which may impact methods of customer-support delivery.

In creating a network, take advantage of specialized expertise and resources at different sites. Encourage communication between centers to promote information exchange. For example, hold periodic in-person meetings or video-conferences for customer support personnel. Make sure each local support unit knows where to locate expertise.

Further readings

Gallagher, R. (1995). Effective software customer support. New York, NY: International Thomson Computer Press.

Muns, R. (1993). The help desk handbook. Colorado Springs, CO: The Help Desk Institute.

5.2.5 Use telephone support to solve problems quickly

When operating a remote customer support facility, remember that your primary goal is to fix the problem or answer the question as quickly as possible.

The need for speedy disposition of calls should not preclude attending to customer education needs. Even so, educating the customer, while important, is a secondary goal of telephone support.

Face-to-face coaching emphasizes a more educational approach to customer than does telephone support. In-person coaching seeks to develop learner confidence and general knowledge; it is more time-consuming, but helps learners build skills and knowledge that is transferable to different problems.

Remote support differs from face-to-face contact in two important respects. In telephone contact, the support provider is unable to observe users at the computer, a necessary part of in-person coaching. In addition, telephone contact uses a communication channel, the phone line, whose use needs to be controlled at both ends. This constraint imposes stricter limits on the amount of time spent in a telephone customer support interaction.

Further readings

Gallagher, R. (1995). Effective software customer support. New York: International Thomson Computer Press.

Microsoft. (1995). Microsoft sourcebook for the help desk. Redomond, WA: Microsoft Press.

Muns, R. (1993). The help desk handbook. Colorado Springs, CO: The Help Desk Institute.

5.2.6 Be systematic in your problem-solving efforts

When a customer has a problem with software or hardware, you need to find out from the customer what she / he is trying to accomplish and what is going wrong. Think of this process as being like a medical diagnosis, and follow these steps:

1. Get a general idea of the problem. For example, “The program is stuck.” Also, get an idea of how much experience the customer has with the system or program.
2. Ask questions to extract details of the symptoms. What specifically is the problem? How does the user know there is a problem? When did the user first notice? Any error messages? What is the program and hardware platform? Finally, if you have access to a hardware and software configuration comparable to the user’s and can duplicate the user’s situation, do so.
3. Formulate a hypothesis about what may be wrong. Consult appropriate reference materials as needed.
4. Test the hypothesis. Either perform the test yourself on your own system, or have the user try out your proposed solution.

Throughout this process, consider whether you will be able to resolve the problem by phone. You may need to refer the problem to a “specialist” or have the user send in additional information so that the problem can be examined in more detail.

Further readings

Gallagher, R. (1995). Effective software customer support. New York: International Thomson Computer Press.

Microsoft. (1995). Microsoft sourcebook for the help desk. Redomond, WA: Microsoft Press.

Muns, R. (1993). The help desk handbook. Colorado Springs, CO: The Help Desk Institute.

5.2.7 Use algorithms to diagnose problems

Effective problem-solvers and diagnosticians often use a set of rules or an algorithm to guide their investigations.

As a customer-support technician, you should begin investigations by obtaining basic information about the caller's question and then using algorithms to guide further diagnostic questions and flush out common problems.

Sometimes algorithms are presented as flow charts or decision tables. They may just be lists of commonly asked questions. They may exist as oral history among support personnel or be formalized in printed or electronic form.

Use records of interactions with customers to generate algorithms for frequently occurring problems. In general, 80 percent of help calls represents 20 percent of the possible problems which can occur. Algorithms for common problems will help front-line support personnel quickly resolve most incoming calls.

Empower callers to diagnose common problems on their own by teaching them algorithms.

Further readings

Gallagher, R. (1995). Effective software customer support. New York: International Thomson Computer Press.

Microsoft. (1995). Microsoft sourcebook for the help desk. Redomond, WA: Microsoft Press.

Muns, R. (1993). The help desk handbook. Colorado Springs, CO: The Help Desk Institute.

5.2.8 Balance efficiency with attention to interpersonal details

In a remote customer support operation, incoming calls must be routed and responded to quickly. Even so, balance efficiency with attention to interpersonal aspects of the interaction.

Calls may be routed by electronic equipment (e.g., programmed selection menus) or by humans. If workers are handling the calls, they should follow these steps:

Greet the caller. Put users at ease by greeting them personally. Identify yourself, ask the user's name, and address the caller by name. Use the greeting to establish a relationship / alliance with the user. Mechanical, impersonal greetings may alienate users.

Identify the customer. Obtain information necessary to document the call, including the user's name and where he / she is calling from.

Resolve or refer the problem. Evaluate the problem. Let the caller know what you think the problem is and what you are going to do to resolve it. Determine whether you can resolve it over the phone. If you are unable to resolve the problem at this time, arrange for an appropriate alternative.

Close the call. Summarize any outstanding issues and indicate who is responsible for the next action (e.g., caller must send information, or you have to contact the software manufacturer and will get back to the caller). Close with a pleasant statement such as, "Thanks for calling" or "Have a good day."

Document the call. Complete necessary documentation. Documentation may include: a record of the nature of the problem and its resolution; the amount of time the call took; where the problem was routed if not resolved; and follow-up requirements for unresolved problems.

Further readings

Gallagher, R. (1995). Effective software customer support. New York: International Thomson Computer Press.

Microsoft. (1995). Microsoft sourcebook for the help desk. Redomond, WA: Microsoft Press.

Muns, R. (1993). The help desk handbook. Colorado Springs, CO: The Help Desk Institute.

5.2.9 If you can't help, don't waste a customer's time

When handling customer-support calls, determine as quickly as possible whether you can resolve the caller's problem during the initial phone contact. Some of the reasons you may not be able to immediately resolve it include:

- You must consult with the software or hardware vendor.
- You must consult with someone else with more expertise.
- You do not have enough information from the caller to solve the problem. For example, the caller may need to send you files or other data which can be investigated directly.

If you cannot resolve the problem immediately, tell the caller as soon as possible. Do not waste the caller's time, and your own, trying to solve a problem that is beyond your resources or expertise. Specify what action needs to be taken and by whom.

If you will turn the problem over to someone else at your site, route the caller directly and immediately, if possible. Do not put the caller on hold for long periods of time. Do not require the caller to return to the end of the incoming call queue.

If the problem requires that you consult with someone else, do not make the caller wait, unless you can complete this consultation quickly (e.g., the "expert" is available at your site or easily reachable by phone). If conference calls are technically feasible, have the caller stay on the line and participate in the consultation.

If the consultation cannot be completed at this time or if you require additional information, tell the caller and give an estimate of when she/he can expect a solution. Be clear about what he/she is required to do and what you will do. Be sure some kind of follow-up procedure is in place.

Further readings

Gallagher, R. (1995). Effective software customer support. New York: International Thomson Computer Press.

Microsoft. (1995). Microsoft sourcebook for the help desk. Redomond, WA: Microsoft Press.

Muns, R. (1993). The help desk handbook. Colorado Springs, CO: The Help Desk Institute.

5.2.10 Help customers trouble-shoot

Although the primary goal of telephone customer support is to solve the problem quickly, educating the caller is an important secondary goal. Determine the caller's approximate level of expertise so you can tailor the level of information you provide.

If you are using a diagnostic algorithm to guide your questions, let the caller know (e.g., "Your problem sounds like it's either a problem with the installation or a corrupted file. Let's look for the possibility of a corrupted file. First, was there just a hardware or power failure?"). Advise the customer to use the same procedure in the future if a similar problem arises.

If you refer the caller to a manual or on-line help, don't stop there. Go through the relevant section of the manual or guide the customer through an on-line help system until she/he finds the required information.

Further readings

Gallagher, R. (1995). Effective software customer support. New York: International Thomson Computer Press.

Microsoft. (1995). Microsoft sourcebook for the help desk. Redomond, WA: Microsoft Press.

Muns, R. (1993). The help desk handbook. Colorado Springs, CO: The Help Desk Institute.

5.2.11 Manage human resources

Effective customer support depends on an effective staff having clear goals and objectives and being provided adequate support, training, incentives, and supervision.

Develop clear goals and objectives for effective customer support. Let support staff know of the goals and objectives, which will likely concern:

- technical and subject matter knowledge of software applications;
- interpersonal skills;
- adherence to call protocol (greeting, record keeping);
- understanding customer's needs;
- trouble-shooting and problem solving ability; and
- awareness of need to refer the problem to someone else.

Encourage professional growth. Enable staff to keep up with new technologies and obtain new skills by encouraging and supporting attendance at training sessions and conferences. Encourage participation in professional organizations. Encourage and reward suggestions for improving customer support or other parts of the operation.

Finally, evaluate staff performance, either by monitoring calls or relying on customer satisfaction surveys. In either case, make it clear to staff exactly what your procedures are and how their performance appraisals will be affected. Use the information gained to determine individual and overall training and performance improvement needs. Use evaluation as the basis for rewarding good performance.

Further readings

Gallagher, R. (1995). Effective software customer support. New York: International Thomson Computer Press.

Microsoft. (1995). Microsoft sourcebook for the help desk. Redomond, WA: Microsoft Press.

Muns, R. (1993). The help desk handbook. Colorado Springs, CO: The Help Desk Institute.

5.2.12 Consider automation and consultants

Consider using automated tools for customer support and contracting with outside firms or consultants to provide all or part of the support function. But, before making decisions about automation or contracting, take projected system growth and changes into account.

While most customer support or help desk operations still center around in-person and telephone interactions, many organizations are increasingly using automation to improve cost effectiveness. Over the past few years, developers have produced more powerful software and hardware solutions for various aspects of the telephone support process. In addition, many organizations have supplemented telephone support with the use of fax responses, which are especially helpful for common questions that require detailed answers.

You can contract out all or part of the support function. A rapidly growing industry of vendors is providing this service. Given the need to support a wide variety of software, you can take advantage of the broader expertise and service facilities of such firms. In such arrangements, you can choose to have the support function located on-site or off-site. You can use consultants to cover peak periods by diverting calls above a specific volume to the support services vendor. You can also use contractors to provide off-hours coverage, if needed.

Further readings

Gallagher, R. (1995). Effective software customer support. New York: International Thomson Computer Press.

Johnson, B. (1995). Outsourcing software support: 1995 players, options, benchmarks. Westborough, MA: Dataquest. Obtain from Dataquest, 9 Technology Drive, PO Box 5093, Westborough, MA 01581-5093. Voice: (508) 871-6287.

Microsoft. (1995). Microsoft sourcebook for the help desk. Redomond, WA: Microsoft Press.

Moad, J. (1994, December 15). Outsourcing the help desk: First aid or folly? Datamation Magazine

Muns, R. (1993). The help desk handbook. Colorado Springs, CO: The Help Desk Institute.

5.2.13 Consider options for call routing

As the manager of a customer-support operation, balance cost-effectiveness with customer satisfaction when considering your options for routing telephone calls.

You may want a caller's first contact to be with a human who can answer general questions and transfer calls to technicians. An automated call handler also can efficiently do the job.

Determine callers' needs and expectations for the customer support interaction, and decide what tone you want to set. If a more personal atmosphere is essential, use human call routing.

Options for automating telephone call routing include:

- **Interactive voice response systems** that provide callers with spoken menus of choices for call routing;
- **Automated call directors** that gather information about the flow of calls, wait times, call times, etc.;
- **Call management systems** that combine functions of interactive voice response with automated call directors.

If you choose to automate call routing, remember that callers have time constraints and there are limitations to their working memory. As a result, automated call routing systems should:

- permit users to make choices quickly;
- limit the levels of menus and the number of choices per menu to three or four;
- tell callers at the beginning of each menu how many menu choices there are (e.g., "Please select one of the following three choices");
- let users who are on hold choose to wait or leave a message;
- always give users the option to press "0" to speak with a live operator; and
- inform callers about all options, such as bypassing menus or leaving a message.

Further readings

Gallagher, R. (1995). Effective software customer support. New York: International Thomson Computer Press.

Microsoft. (1995). Microsoft sourcebook for the help desk. Redomond, WA: Microsoft Press.

Muns, R. (1993). The help desk handbook. Colorado Springs, CO: The Help Desk Institute.

5.2.14 Support problem resolution

Implement procedures and get information to support problem resolution.

Information gathering

Keep records of callers' problems and questions. These records can provide information about frequent problems for use by the support staff. Experts say 80 percent of the support work will require 20 percent of the expertise; identify that 20 percent.

Gather information about human and machine resources and use the data to plan future resource deployment. Obtain information about call times, volumes, wait times, etc.

In addition to quantitative information, collect customer feedback. Conduct user surveys to find out whether customers are getting what they need and if they are pleased with the service they receive.

Re-routing and tracking

Establish procedures for calls which are re-routed because the customer's problem cannot be resolved during the initial phone contact. To handle such situations efficiently:

- Develop procedures to help staff members determine what resources are available within or outside the organization to handle problems that can't be solved at one particular site.
- Develop procedures for tracking problems that require consultation. Draw clear lines of responsibility when a problem is handed off. Identify who makes sure the problem is resolved and who notifies the customer.

Automated systems

Automated systems that support problem resolution are now available. Options for such support systems include:

- **Transaction history data bases** to capture information about each caller's questions and problems. Use transaction history to identify frequently occurring problems. You can also use information about a customer's previous requests to help service the current request.
- **Status data bases** to track problem status and flag unresolved problems.

- **Knowledge bases** to provide problem-solution information. These can be home-grown or purchased. Some software vendors provide knowledge bases on CD-ROM which can be used by support personnel or could be made available directly to system users.

- **On-line support services** such as CompuServe, through which software vendors may provide searchable libraries of problem-related information.

- **On-line support forums** for specific software products via on-line services or the Internet. Use these forums to get questions answered and to chat with other product users.

Further readings

Gallagher, R. (1995). Effective software customer support. New York: International Thomson Computer Press.

Microsoft. (1995). Microsoft sourcebook for the help desk. Redomond, WA: Microsoft Press.

Muns, R. (1993). The help desk handbook. Colorado Springs, CO: The Help Desk Institute.

To see a multimedia example that illustrates this principle, point your web browser to:

http://clipt.sdsu.edu/posit/ex/0051.html

5.2.15 Use customer support organizations

Use organizational resources which provide information about customer support and the help-desk function. Two important organizations are:

Help Desk Institute
1755 Telstar Drive, Suite 101
Colorado Springs, CO 80920-1017

Voice: (719) 531-5138
Voice: (800) 528-4250
Fax: (719) 528-4250

The Help Desk Institute provides training, publications, educational materials, and a networking forum for customer support practitioners. The HDI also provides training at national or regional conferences or at your location.

Software Support Professional's Association (SSPA)
11858 Bernardo Center Drive, Suite 101C
San Diego, CA 92128

Voice: (619) 674-4864
Fax: (619) 674-1192

The SSPE is a professional organization for support practitioners from leading software companies. SSPA's Professional Services Division provides consultation on various customer support issues.

5.2.16 Stay up to date on customer-support publications

Use printed resources which provide information about customer support and the help-desk function. Some important resources are:

Periodicals

United Publications, Inc.
Box 995
Yarmouth, ME 04096

Voice (207) 846-0600
Fax (207) 846-0657

Publishes monthly Service News newspaper providing information specifically related to customer support service; provides information on such issues as help-desk management, software support, network support. Also publishes annually The Help Desk Manager's Handbook (see below), a buyers guide and a guide to hardware maintenance. Offers trade shows and conferences.

Books

Gallagher, Richard, (1995). Effective software customer support. New York: International Thomson Computer Press. Presents an overview of the customer support function.

Harris, Allison, (Ed.), (1994). The help desk manager's handbook. Yarmouth, ME: United Publications. Published annually. Reference tool for help desk automation software, outsourcing.

Johnson, Bob, (1995). Outsourcing software support: 1995 players, options, benchmarks. Westborough, MA: Dataquest. Obtain from Dataquest, 9 Technology Drive, PO Box 5093, Westborough, MA 01581-5093. Tel (508) 871-6287.

Microsoft (1995). Microsoft sourcebook for the help desk. Redomond, WA: Microsoft Press. Comprehensive and detailed guide to customer support.

Muns, Ron (1993). The help desk handbook. Colorado Springs, CO: The Help Desk Institute.

5.2.17 Demonstrate empathy with customers

Think back to when you first learned how to use a computer. Did you learn in the privacy of your own home where no one could see your mistakes? Was anyone looking over your shoulder waiting for you to finish? Was it difficult to ask for help? Did you find the experience frustrating?

If you are going to work effectively with computer novices, you have to understand their "newness" in a situation in which you are an expert. You must show empathy, which means understanding people from their frame of reference. Empathy is both a receptivity to others' feelings and goals and a response which communicates this understanding.

You can practice empathy by taking the following four steps:

1. Listen to the learner. Try to see things from the learner's perspective, as if you were in her or his shoes. Listen for underlying feelings and implications behind his words. You need to suspend judgment and avoid stereotyping.

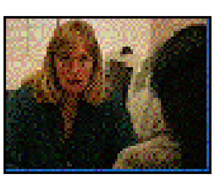
2. Process the information you get from listening and observing. Be careful to distinguish between your observations and your interpretations and impressions.

3. Tell the customer what you have observed and heard and what you think her or his perspective is.

4. Ask for feedback to check out the accuracy or reasonableness of your response.

Further readings

Rogers, C. (1983). Freedom to learn. Columbus, OH: Charles E. Merrill.



To see a multimedia example that illustrates this principle, point your web browser to:

http://clipt.sdsu.edu/posit/ex/0054.html

5.2.18 Use active listening skills with customers

Talk may be cheap, but good listening isn't.

People mostly think of and perform listening as a passive process. We take in or receive messages from others. Period. As the name implies, active listening requires the listener to work at understanding the speaker.

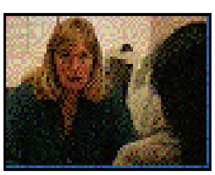
You may think you do this all of the time. Probably not. Do you always pay attention to people's verbal and non-verbal messages? Do you consistently respond with statements and questions to elicit more specific information?

Active listening allows you to obtain the information you need to help your customers. Your attention, comments, and questions will convey your interest and desire to understand, motivating them to work harder and bolstering their self-esteem. It also will encourage them to express their goals and describe their obstacles.

Further readings

Evans, D., Hearn, M., Uhlemann, M., & Ivey, A. (1984). Essential interviewing: A programmed approach to effective communication (2nd ed.). Monterey, CA: Brooks/Cole.

McKay, M., Davis, M., and Fanning, P. (1983). Messages: the communication skills book. Oakland, CA: New Harbinger.



To see a multimedia example that illustrates this principle, point your web browser to:

http://clipt.sdsu.edu/posit/ex/0054.html

5.2.19 Give customers your undivided attention

Olympians don't take home gold medals by chance. They prepare for the challenge, mentally as well as physically.

Dealing with people can be as difficult as clearing a high hurdle. Before you interact with a customer, prepare yourself as if you were going to an athletic event. Clear your mind. Focus on the person. Who are they? What are they trying to do?

Reduce distractions. Deal with one customer at a time. Don't take phone calls while you are helping someone. Let others know you will get to them later.

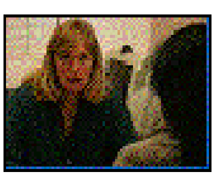
Express interest—through your posture, gestures, and tone of voice—in what the customer is trying to accomplish. Display a relaxed, natural body posture. Maintain eye contact but don't start a stare-down. Be sensitive to cultural differences related to amount of eye contact and body language.

Unless the customer is a non-stop talker, let the customer finish talking before you make a decision about how to help. Don't interrupt, except to ask for clarification, and don't change the subject. Suspend judgment and avoid making assumptions about what users are going to say or what they are thinking. Premature conclusions may distort your perception.

Further readings

Evans, D., Hearn, M., Uhlemann, M., & Ivey, A. (1984). Essential interviewing: A programmed approach to effective communication (2nd ed.). Monterey, CA: Brooks/Cole.

McKay, M., Davis, M., & Fanning, P. (1983). Messages: the communication skills book. Oakland, CA: New Harbinger.



To see a multimedia example that illustrates this principle, point your web browser to:

http://clipt.sdsu.edu/posit/ex/0054.html

5.2.20 Help customers clarify their thoughts and questions

Pay attention to your customer's verbal and non-verbal messages and respond with statements and questions that help clarify his or her thoughts and questions. Paraphrase his or her words, ask "clarifying questions," and seek feedback to make sure you have correctly understood him or her.

Paraphrasing

State in your own words the main ideas you heard the user communicate. Try to pick out the central points of the message and reflect them back. Paraphrasing: indicates you are interested; helps develop a working relationship; reduces the chance of miscommunication; encourages users to be more specific and clarify their thoughts; may help you to remember what was said; and can sharpen your listening skills.

Clarifying

If you do not understand, ask for more information until you get a clearer picture of the user's intention or problem. Acknowledge your confusion. Ask the user to repeat, clarify, or give you an example. If his or her response is vague or abstract, ask them to be more specific. Try to be sure your interpretation of key terms is the same as the user's. For example: you might ask, "What do you mean by 'job information?' "

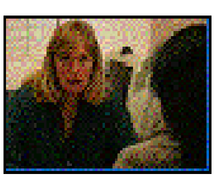
Seeking feedback

Ask the user to confirm whether you have understood him/her and to make corrections if you have not.

Further readings

Evans, D., Hearn, M., Uhlemann, M., & Ivey, A. (1984). Essential interviewing: A programmed approach to effective communication (2nd ed.). Monterey, CA: Brooks/Cole.

McKay, M., Davis, M., & Fanning, P. (1983). Messages: the communication skills book. Oakland, CA: New Harbinger.



To see a multimedia example that illustrates this principle, point your web browser to:

http://clipt.sdsu.edu/posit/ex/0054.html

5.2.21 Keep calm when dealing with angry customers

Many of us feel threatened, angry, or confused when people are angry at us. Deal with angry customers by first controlling your own anger or fear, then defuse their hostility by using your interpersonal skills.

Remember that anger is often a cover for fear or other unpleasant emotions. Underneath, the customer may be anxious about his or her employment situation. He/she may feel neglected by you, and, therefore, offended. Or he/she may be frustrated or embarrassed by inexperience with computers. It will be easier to deal with your own anger or upset and his or her anger if you try to get a sense of what the customer's underlying feelings are.

To get your own feelings under control, try one or more of the following techniques:

- Take a few slow, deep breaths.
- Give yourself time to think. Do not respond impulsively. Count backwards from 10.
- Imagine a peaceful scene that has a calming effect on you.

To defuse the user's hostility:

- Interrupt if you need to. Call the person by name.
- Model calmness and self-control. Speak slowly in an even, normal tone.
- Ask the user speak slowly so you can understand. Request that he/she sit down. Start to sit down yourself, but remain standing if the user does not sit down.
- Tell the user that you want to help.
- Show understanding of the customer's perspective. Try to put yourself in the customer's shoes.
- Encourage the customer to talk. Ask what he is trying to accomplish. Ask detailed questions. If the customer is still upset, try to ask about matters not directly related to the immediate problem (e.g., family background, employment situation).

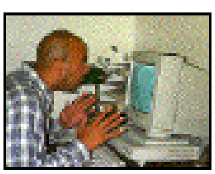
- With great care, use humor. Humor can be an effective way to defuse anger or other emotional distress. However, be cautious, since some people may feel you are not taking them seriously.

- If none of the above works, break off the conversation temporarily. Let the user know you need to do something else but will be available later.

Further readings

Goldstein, A. (1981). Psychological skills training: The structured learning technique. New York: Pergamon Press.

Goldstein, A. (1988). Anger control training. In Goldstein, A. The Prepare Curriculum: Teaching prosocial competencies. Champaign, IL: Research Press.



To see a multimedia example that illustrates this principle, point your web browser to:

http://clipt.sdsu.edu/posit/ex/0055.html

5.3 Help customers learn new skills

5.3.1 Respect learners

Respecting someone means valuing them as worthwhile. People naturally seek to grow and learn. It is important that you believe that your customers can learn and change. Learners who feel you respect them are more likely to learn.

There are many ways to communicate respect for customers:

- Tell them you are interested in working with them and want to help them get what they need from the system. Be empathic, ask questions about things they value, listen intently to them, and express an interest.

- Respect differences. Listen to your customers' perceptions and opinions and try to appreciate them. Accepting another person's way of doing things or opinion does not mean you agree, just that you accept their right to think or act differently from you.

- Focus on their strengths. Don't look down on learners because they don't know things that seem obvious to you. If they are struggling to learn a new skill, keep in mind the things they have accomplished.

- Respect cultural differences. Cultural factors may affect all aspects of the learning situation, including motivation, attitude toward learning, willingness to ask for help, and attitude toward helpers and authority figures.

- Focus on what you can learn from them. Students can be excellent teachers.

Further readings

Aspy, D., & Roebuck, F. (1972). An investigation of the relationship between student levels of cognitive functioning and the teacher's classroom behavior. Journal of Educational Research, 65(8), 365-368.

5.3.2 Create a warm learning environment

Learners who seek help have more learning successes. Coaching helps learners stay with the task and can build their confidence. Without coaching, or advisement, learners may get discouraged and quit prematurely. Unfortunately, few learners ask for help, and those who most need help are least likely to seek it.

For these reasons, you should take an active role in making learners feel welcome and in initiating helping activities.

- Introduce yourself to customers and let them know that your job is to help them get what they need from the system. Tell them that you are familiar with computers as well as the software.

- If you know a learner from a previous visit, acknowledge him / her. If possible, let him / her know that you remember what he / she has learned so far about using the system.

- Walk around the room and chat with learners. Find out what brings them to the center. What are they trying to accomplish this visit? Is it their first time here? Have they ever used computers before? Are they finding what they need? Would they like some help?

- Avoid coming across as an “authority figure.” Sit next to learners if possible, rather than standing. Don’t turn your back during a conversation. In certain cultures, people may need you to be an authority figure, so there may be some exceptions to this guideline.

- Use interpersonal and coaching skills to help learners stay motivated and engaged.

Further readings

Karabenick, S., & Knapp, J. (1988). Help seeking and the need for academic assistance. Journal of Educational Psychology, 80, 406-408.

Steinberg, E. (1989). Cognition and learner control: a literature review, 1977-1988. Journal of Computer Based Instruction, 16(4), 117-121.

5.3.3 Give customers tools to help them "learn to learn"

Humans are distinguished from other species by their ability to use tools to save time and effort. In the computer and information age, we still use tools, but they aren't necessarily obvious to the casual observer.

With this in mind, you should show customers how to use the computer system's support resources and documentation. Teach them strategies for learning. By encouraging learners and teaching them how to learn, you can help build their confidence and independence.

- Show customers how to use software tutorials, on-line help, and manuals and how to explore menus and toolbars to learn new functions. .
- Introduce customers to the computer system's how-to guides; show them how and why they might use them; and encourage them to construct their own guides for new tasks.
- Teach or model learning strategies. Suggest that customers rehearse a new skill through practice or repetition. Ask them to elaborate on newly acquired knowledge by explaining it in their own words, or by telling you how new knowledge or skills are like or unlike something they already know. Suggest note taking.
- Teach customers to divide a task into subgoals, each with its own measure of success. When learners have only a larger, final goal to measure their progress, they may be disappointed by the gap between their current performance and the final goal.

Further readings

Bandura, A., & Schunk, D. (1981). Cultivating competence, self-efficacy, and intrinsic interest through proximal self-motivation. Journal of Personality and Social Psychology, 41, 586-598.

Weinstein, C. (1988). Assessment and training of student learning strategies. In R. Schmeck, (Ed.). Learning Strategies and Learning Styles. New York: Plenum Press.

To see a multimedia example that illustrates this principle, point your web browser to:

http://clipt.sdsu.edu/posit/ex/0058.html

5.3.4 Teach and model strategies and principles

A customer comes to you with a problem with a computer or a particular piece of software. You're tempted to just solve the problem and return to whatever you were doing. If you do, you'll miss a learning opportunity.

Learners who understand and can use problem-solving strategies feel more in control of the outcome and are more confident in their ability to succeed. Learners who understand strategies and principles in one area are often able to apply them to other tasks.

Therefore, you should strive to teach strategies and general principles to help users learn the computer and the software system. Explain how strategies and general principles will enhance their performance. Demonstrate the approach by showing the learner how; then encourage the learner to practice.

Make sure you explain:

- the function and purpose of the strategy or principle;
- how to use the strategy / principle, what actions to perform;
- when and why to use the strategy / principle; and when it is likely to be effective.

Here are some examples of teachable strategies:

- How to use search strategies to obtain information. Show learners how to use "Find" in Microsoft Word, or "Find File" on the Macintosh. If learners are using the World Wide Web, teach them how to use a simple Web search engine.
- How basic text editing works. Explain that the rules are similar in different programs and systems.

Further readings

Bandura, A. (1982). The self and mechanisms of agency. In J. Suls (Ed.), Psychological perspectives on the self. (Vol. 1, pp. 3-39). Hillsdale, NJ: Erlbaum.

O'Sullivan, J., & Pressley, M., (1984). Completeness of instruction and strategy transfer. Journal of Experimental and Child Psychology 38, 275-288.

To see a multimedia example that illustrates this principle, point your web browser to:

http: / / clipt.sdsu.edu / posit / ex / 0058.html

5.3.5 Teach new skills by modeling them to learners

Learners acquire new behaviors or skills by watching someone demonstrate the desired performance, then imitating the model. This technique is called observational learning.

You should demonstrate successful behaviors, reward learners for successes, and reward others whom learners observe.

When someone observes someone else do something successfully, the observer usually ends up believing they, too, can perform the task. This means the learner's self-efficacy is enhanced. Simple behaviors can be learned just by watching; more complex behaviors require practice.

Observational learning consists of four subprocesses:

- **Attention**. Learners must follow closely the demonstrated behavior.

- **Memory**. Learners encode verbal or visual information from the modeled performance and store it in memory. They may mentally rehearse the behavior before actually trying to perform it.

- **Production**. Learners perform the task by translating their memories into actions.

- **Motivation**. Learners are more likely to repeat behaviors they believe will result in positive outcomes, such as success or rewards.

If you are serving as a model, there are things you can do to help learners. While modeling a behavior, say what you are doing. Think aloud. Say how you decide to do important steps of the modeled behavior. This "running commentary" on modeled activities engages and focuses learners' attention and highlights particularly relevant parts of the behavior. Commentary also provides verbal labels for the behavior and may help learners encode the information in their memory.

Model positive outcomes and try to ensure that learners experience positive outcomes. Learners who observe or experience positive outcomes are more likely to form positive expectations about future outcomes. This motivates learners to persist with a task and to practice and learn new behaviors.

Further readings

Meichenbaum, D. (1977). Cognitive behavior modification: An integrative approach. New York: Plenum.

Schunk, D. (1989). Social cognitive theory and self-regulated learning. In B.J. Zimmerman and D. Schunk (Eds.), Self-regulated learning and academic achievement: Theory, research and practice (pp. 83-110). New York: Springer-Verlag.

Thelen, M.H., Fry, R.A., Fehrenbach, P.A. & Frautschi, N.M. (1979). Therapeutic videotape and film modeling: A review. Psychological Bulletin, 186(4), 701-720.

To see a multimedia example that illustrates this principle, point your web browser to:

http://clipt.sdsu.edu/posit/ex/0058.html

5.3.6 Let learners master new tasks by doing them

Help customers achieve their goals by guiding their efforts. Coaching or guided learning is particularly helpful for novice computer users.

Try to achieve a balance between your activity and the learner's activities. Encourage novice learners to perform procedures you have modeled or explained. At the same time, provide support to guide their efforts. Allow learners to control the mouse and keyboard while you observe and comment. Ask them to talk about what they are doing and encourage them to ask questions.

Rather than give solutions, provide cues to help learners identify and correct their errors. Point out or describe task-related cues, such as the kind of error made or the location of the error. Then guide the learner's efforts to find and correct the error.

Learners who correct their own errors develop a sense of control over the learning process. Learners' perceived control over the process results in enhanced self-efficacy and motivation. In addition, when learners correct their own errors, they must process information more deeply. Processing information at deeper levels improves learning and retention.

Further readings

Merrill, D., Reiser, B., Merrill, S., & Landes, S. (1995). Tutoring: Guided learning by doing. Cognition and Instruction, 13(3), 315-372.

To see a multimedia example that illustrates this principle, point your web browser to:

http://clipt.sdsu.edu/posit/ex/0058.html

5.3.7 Encourage and support learner effort

Luck isn't an issue; determination and effort are.

Promote this attitude among your customers. Encourage them to apply effort, then point out when their effort leads to success. When you remind them that they can perform the task, you'll motivate them to try again.

People who blame past failures on factors over which they have control (such as effort level) show significant improvements in performance. In contrast, learners who believe their failures are related to factors they can't control are more likely to become discouraged and depressed. They may become so convinced of their likely failure that they give up.

Learners who believe their effort is a significant factor in performance are more motivated to strategically approach a challenge. Applying strategies to a problem requires extra effort, which learners apply only if they believe the effort won't be in vain.

Try to elicit additional learner effort by:

- letting learners know when prior successes are related to effort;
- letting learners know that they can achieve better results with more effort;
- praising learners when they exert effort; and
- trying to persuade learners to persist, letting them know you believe they can succeed.

Further readings

Borkowski, J., Carr, M., Rellinger, E., & Pressley, M. (1990). Self-regulated cognition: Interdependence of metacognition, attributions, and self-esteem. In B.F. Jones & L. Idol (Eds.), Dimensions of thinking and cognitive instruction (pp. 53-92). Hillsdale, NJ: Lawrence Erlbaum Associates.

Carver, C., & Scheier, M. (1990). Origins and functions of positive and negative affect: A control-process view. Psychological Review, 97, 19-35.

5.3.8 Tell customers that the task is difficult

Tell customers that learning new technology and information systems is a difficult process. It can be frustrating, time consuming and intellectually taxing. Novices (such as new computer users) who have a realistic understanding of the challenge ahead are less likely to blame themselves for failures.

Learners who think a task is easy and should be mastered quickly may set unrealistically high learning goals and then perceive their performance as inadequate. They may also use superficial learning strategies which cause them to fail. Such learners may become very discouraged, and may withdraw completely from the learning effort.

Further readings

Carver, C., & Scheier, M. (1990). Origins and functions of positive and negative affect: A control-process view. Psychological Review 97, 19-35.

Schommer, M., Crouse, A., & Rhodes, N. (1992). Epistemological beliefs and mathematical text comprehension: Believing it is simple does not make it so. Journal of Educational Psychology, 84, 435-443.

5.3.9 Give learners informational feedback

Support learners by providing informational feedback. Feedback occupies a central place in the learning process because it can have a strong positive effect on learning.

Informational feedback is:

- telling customers that their responses/answers were correct or incorrect;
- giving customers information and cues that will help them to fix their mistakes; and
- reminding them of their goals.

Keep in mind the following guidelines:

- Confirm correct responses during the task performance, not just at the end.
- Provide immediate error feedback, especially during lengthy, complex tasks.
- For simple, low-level errors related to arbitrary or factual knowledge (e.g., syntax errors), indicate there has been an error and, optionally, provide the correct answer.
- For higher-level errors related to concepts, processes, or incorrect goals and strategies, point out task-related cues such as the kind of error made or the location of the error. Then guide customer efforts to find and correct the error.

When learners receive immediate confirmation of correct responses they know they are going in the right direction. This knowledge encourages them to continue. You want to prevent learners from becoming frustrated by long, seemingly aimless searches. Excessive frustration may cause learners to give up. Learning results from correcting the error, not from spending a long time trying to find it.

Further readings

Bangert-Drowns, R.L., Kulik, C., Kulik, J., & Morgan, M. (1991). The instructional effect of feedback in test-like events. Review of Educational Research 61, 213-238.

Merrill, D., Reiser, B., Merrill, S., & Landes, S. (1995). Tutoring: Guided learning by doing. Cognition and Instruction 13(3), 315-372.

5.3.10 Obtain learner feedback

Ask customers for feedback after you have provided technical or instructional support. Use their comments to improve your coaching skills.

Questions to ask customers include:

- Were you able to achieve what you were seeking to do?
- Are you satisfied with the results?
- Could I have done something differently to be more helpful?
- Did you get enough direction from me? Too much?
- Were my instructions clear? Did you understand examples I provided?
- Did you learn anything beyond the specific information you came in for?
- Did you feel comfortable asking questions? What would make you feel more comfortable?
- Would you ask for help again?

6. Quantitative data

Because **quantitative data** can be difficult to understand, this section focuses on how to present essential data in a clear, meaningful way. Approaches for using color, labels, shapes and dimensionally to aid comprehension are presented. Also included are recommendations on pie charts, line graphs, and maps, and the best ways to represent trends and portions of a whole.

6.1 Graphing data

6.1.1 Keep graphs simple

Graphs should not display more than four lines on a single set of coordinates. If more than four sets of data must be displayed, select logical groupings of the data and construct multiple graphs that contain subsets of the data.

As a rule of thumb, assume that working memory can hold from four to seven "chunks" of data for processing at a time. Each line on a graph is processed as a chunk as are the coordinate axes. Thus, if more than four lines are included in a single graph, some readers may have difficulty holding all of the information from the graph in working memory and may struggle to make the comparisons between all of the curves.

Further readings

Kosslyn, S.M. (1985). Graphics and human information processing: A review of five books. Journal of the American Statistical Association, 80(391), 499-512.

Schmid, C.F. (1983). Statistical graphics design principles and practices. New York: John Wiley & Sons.

6.1.2 Use only one scale per axis on a graph

When graph data contains significant changes over a small portion of the range of data, it is tempting to emphasize this region of a scale by expanding the scaling factor for this region. Resist the temptation.

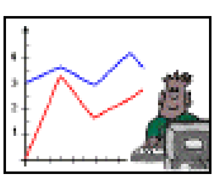
Since most published graphs do not expand the scaling factor, readers will not expect this type of presentation. They are likely to ignore the changes in the scale on the axes and misinterpret the data.

If your audience includes readers who have limited experience interpreting graphs, it is better to limit graphs to one scaling factor per axis. Graphs in this form are less likely to confuse the reader and are easier to interpret.

Further readings

Haemer, K.W. (1948). Double scales are dangerous. The American Statistician, 2(3) 24.

Schmid, C.F. (1983). Statistical graphics design principles and practices. New York: John Wiley & Sons.



To see a multimedia example that illustrates this principle, point your web browser to:

http://clipt.sdsu.edu/posit/ex/0060.html

6.1.3 Use linear scales when constructing graphs

A relative change in values can be compared more accurately across a graph if you avoid non-linear scales such as logarithmic scales and use linear scales on the coordinate axes instead.

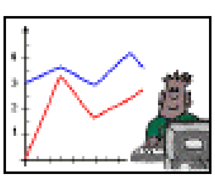
Readers are familiar with linear scales since most graphs in magazines and newspapers have a linear format. When less educated readers encounter graphs that use non-linear scales, they may not recognize that the scales are non-linear because they are so used to seeing graphs with linear scales. This may lead to misinterpretation because equal linear distances measured at different points on the graph do not represent equal amounts of change in a variable.

Non-linear scales are difficult for people who don't have much experience with graphs. However, linear scales are awkward if you are trying to chart widely varying statistics. In this case, you may want to use logarithmic scales so long as you include a clear indication of the nature of the scale. Logarithmic scales can also effectively portray variations in rates of change.

Further readings

Kosslyn, S.M. (1994). Elements of graph design. New York: W. H. Freeman and Company.

Schmid, C.F. (1983). Statistical graphics design principles and practices. New York: John Wiley.



To see a multimedia example that illustrates this principle, point your web browser to:

http://clipt.sdsu.edu/posit/ex/0060.html

6.1.4 Use line graphs when quantity is important

Choose a line graph when the reader needs to be able to extract actual quantities and a bar graph or a pie chart when only relative size is required.

Readers judge positions on the scale on a line graph more accurately than they judge the areas in a pie chart or bar graph. Readers tend to focus on the areas of the bars in a bar chart rather than the height of the bars. For similar reasons, pie charts are best suited to give readers a sense of the parts of the whole. Bar graphs and pie charts are not effective in situations where specific values are needed. For this reason, when accuracy of extracting quantities is important, line graphs should be used.

On the other hand, readers can perceive relative sizes of areas quickly so pie charts and bar graphs work well when relative amounts are what is important.

Further readings

Cleveland, W.S., & McGill, R. (1984). Graphical perception: Theory, experimentation, and application to development of graphical methods. Journal of the American Statistical Association, 79, 531-554.

Cleveland, W.S. (1984). Graphical perceptions and graphical methods for analyzing scientific data. Science, 229, 828-833.

6.1.5 Use line graphs to show trends

Choose a line graph rather than a bar graph when trends are important, because readers readily perceive changes in the slope of a line.

Changes in a rate are more easily perceived through changes in the slope of a line than through variations in the height of bars on a bar graph. For example, readers could see from the slope of a line whether the rate of change in unemployment is increasing or decreasing. It would be more difficult to see the same change in a series of bar graphs.

Further readings

Cleveland, W.S., & McGill, R. (1984). Graphical perception: Theory, experimentation, and application to development of graphical methods. Journal of the American Statistical Association, 79, 531-554.

Schiano, D., & Tversky, B. (1992). Structure and strategy in encoding simplified graphs. Memory and Cognition, 20(1), 12-20.

6.1.6 Place labels next to lines on line graphs

Place labels next to corresponding lines on a graph, rather than identifying the lines through a legend on the graph or in a space outside the graph.

This helps readers interpret line graphs more quickly than when the lines are identified through a legend. When a legend is used, readers must consult the legend to identify each line. This adds an extra step to the process of interpreting the display.

Many spreadsheet programs make it easy to add a legend to a graph. It is better to use a program that puts labels directly on the graph.

Further readings

Kosslyn, S.M. (1994). Elements of graph design. New York: W. H. Freeman and Company.

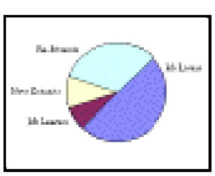
Schmid, C.F. (1983). Statistical graphics design principles and practices. New York, NY: John Wiley.

Tufte, E.R. (1983). The visual display of quantitative data. Chesire, CT: Graphics Press.

6.1.7 Use pie charts to portray parts of the whole

Use a pie chart instead of a split bar chart when the reader is expected to make judgments comparing portions of the whole.

Readers estimate the percentage of the whole more accurately with a pie chart rather than a bar chart. Though most people have more difficulty processing angles than they do processing length, the pie chart is a superior for presenting parts of a whole. Readers establish salient reference angles of zero, ninety, and 180 degrees, which helps them judge the respective angles.



To see a multimedia example that illustrates this principle, point your web browser to:

http://clipt.sdsu.edu/posit/ex/0062.html

6.1.8 Use circles rather than ellipses for pie charts

Popular journals increasingly use 3-D effects to add color and interest to pie charts. However for easy interpretation, pie charts should be displayed as circles rather than ellipses.

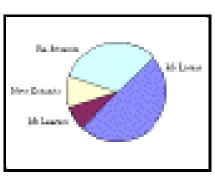
When a pie chart is portrayed as an ellipse and not a circle, the pieces of the pie are distorted. A segment near the axis of the ellipse will appear to have a greater surface area than a segment perpendicular to the axis that represents a similar proportion of the pie; this can lead readers to make incorrect judgements when they compare quantities.

Further readings

Cleveland, W.S., & McGill, R. (1984). Graphical perception: Theory, experimentation, and application to development of graphical methods. Journal of the American Statistical Association, 79, 531-554.

Schmid, C.F., & Schmid, S.E. (1979) Handbook of graphic presentation. New York, NY: John Wiley.

Tufte, E. R. (1983). The visual display of quantitative data. Chesire, CT: Graphics Press.



To see a multimedia example that illustrates this principle, point your web browser to:

http://clipt.sdsu.edu/posit/ex/0062.html

6.1.9 Avoid three-dimensional graphs

Giving graphs the appearance of depth adds interest to the displays, but makes the graphs more difficult to interpret and increases reader errors.

Many software programs have built-in functions for displaying graphs that add a third dimension to bar and line graphs, creating the appearance of depth. It is tempting to use this capability when preparing graphs as it seems to add visual interest to the displays. However, perceptually, three-dimensional graphs are more difficult for readers to interpret accurately. Readers must decide whether to pay attention to the front or back surface of a figure, or an average of the two. Readers are more apt to misinterpret the data because they choose the wrong points.

Reference

Kosslyn, S.M. (1994). Elements of graph design. New York: W. H. Freeman.

Tufte, E.R. (1983). The visual display of quantitative data. Chesire, CT: Graphics Press.

6.2 Mapping quantitative information

6.2.1 Use shaded maps for geographically distributed data

Use shaded-area maps to represent data that is quantifiable by geographic regions, such as jobs, levels of unemployment, or other information of interest to job seekers.

In these maps, the value of a variable of interest—such as manufacturing jobs—is identified for specific geographic regions, such as within a county. The values are divided into ranges and each range is assigned a specified shading color or pattern. Each region is shaded with the shading pattern corresponding to the range of the datum for the area.

Use symbols of proportional sizes to represent the different ranges of data for different regions. However, studies have indicated that shaded-area maps are more effective for conveying data of this sort. Map readers may obtain a sense of the overall geographic pattern of the mapped variable, ascertain an actual value associated with a geographic area, and compare data from other maps.

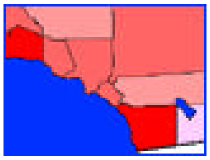
Further readings

Brewer, C.A. (1992). Review of color terms and simultaneous contrast research for cartography. Cartographica, 29(3 & 4) 20-30.

Dent, B.D. (1993). Cartography: Thematic map design. (3rd ed.). Dubuque, IA: William C. Brown Publishers.

Donley, M.W., Allan, S., Caro, P., & Patton, C.P. (1979). Atlas of California. Culver City, CA: Pacific Book Center.

Wood, M. (1993). The maps users response to map design. The Cartographic Journal, 30, 149-153



To see a multimedia example that illustrates this principle, point your web browser to:

http://clipt.sdsu.edu/posit/ex/0064.html

6.2.2 Avoid color combinations that conflict with reality in maps

Maps symbolize the real world, so their coloration should be natural to make them easier to interpret. In general, water should be blue and land should be represented in earth tones.

Research into map representations has shown that when symbols closely resemble the real world, the reader can more easily connect the real world to the mapped representation. Natural color choices aid the viewer in activating the appropriate mental framework, and facilitates processing of the visual information.

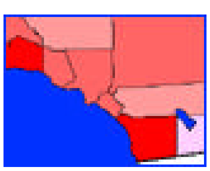
Further readings

Brewer, C.A. (1992). Review of color terms and simultaneous contrast research for cartography. Cartographica, 29(3 & 4), 20-30.

Dent, B.D. (1993). Cartography: Thematic map design (3rd ed.). Dubuque, IA: William C. Brown Publishers.

Donley, M.W., Allan, S., Caro, P., & Patton, C. P. (1979). Atlas of California, Culver City, CA: Pacific Book Center.

Wood, M. (1993). The maps users response to map design. The Cartographic Journal, 30, 149-153.



To see a multimedia example that illustrates this principle, point your web browser to:

http://clipt.sdsu.edu/posit/ex/0064.html

7. Cognitive and physical adaptability

Individuals with disabilities represent a significant segment of California's unemployed population. **Cognitive and Physical Adaptability** are important for any agency that strives for universal access. This section helps you design adaptive technical environments for learners with special needs. Learn how special equipment like screen readers, typographic cueing and speech synthesizers ensure equal access to computer based training for persons with disabilities. Guidelines for providing access to persons with handicaps are also located in this section.

7.1 Design systems so they can adapt to meet the needs of customers with cognitive impairments

7.1.1 Use 'advance organizers' to help customers learn

When you are teaching something, help your customers learn by building a bridge between their existing knowledge and the new material by providing "advance organizers."

Advance organizers foreshadow the main ideas included in the material being presented. An advance organizer may come in a variety of forms, such as a question, a heading, or a picture. Present the most general ideas first, followed by more detailed, specific, concrete ideas and facts.

While helpful to all users, advance organizers are especially helpful for users with cognitive disabilities who have difficulty imposing order on printed or electronically formatted information.

Advance organizers link what users will learn to what they already know. By creating a bridge or connection between new material and existing knowledge, advance organizers help learners make sense of new information, learn it, and remember it. By activating relevant prior knowledge, advance organizers also provide a kind of anchor which helps learners stay focused on the subject.

Further readings

Ausubel, D. P. (1968). Educational psychology: A cognitive view. New York: Holt, Rinehart, & Winston.

Lerner, J. (1988). Learning disabilities: Theories, diagnosis, and teaching strategies (5th ed.). Boston: Houghton Mifflin.

Lynch, E. W., & Lewis, R. B. (Eds.). (1988). Exceptional children and adults: An introduction to special education. Glenview, IL: Scott Foresman.

7.1.2 Provide access for users with cognitive impairments

Some individuals have general mental processing difficulties such as mental retardation or diffuse brain injuries; others have very specific deficits such as limited short-term memories or an inability to remember faces or proper names.

Software designed to be very user friendly is usually kind to people with language or cognitive impairments. The tremendous diversity of cognitive impairments makes it difficult to generalize about effective accommodations, but the following suggestions make software more usable for everyone.

- Make sure all messages and alerts stay on screen until the user dismisses them.
- Make language as simple and straightforward as possible, both on screen and in documentation.
- Use simple and consistent screen layouts.
- Provide overt textual, visual, or auditory cues that direct the users attention to important information.
- Ensure that software is compatible with screen-reading software that converts text to spoken words.

Users with cognitive disabilities, particularly those who have Attention Deficit Disorder (ADD) or acquired brain injuries, often have difficulty processing simultaneous auditory and visual stimuli. Minimize the amount of simultaneous auditory and visual stimuli for these users. If information is presented in more than one mode (e.g., pictures and sound) allow users to select only one mode and easily switch to it. Be sure to let users know what their selection options are and how to accomplish them.

Most users who don’t have cognitive impairments can handle multiple stimuli without becoming distracted or confused. For these users, multiple stimuli or sensory modalities may enhance attention, interest, and retention of information. In contrast, users who have ADD or acquired brain injuries have difficulty screening out or selectively attending to sensory input. Consequently, they may become distracted and mentally overloaded when presented with competing stimuli.

Further readings

Lerner, J. (1988). Learning disabilities: Theories, diagnosis, and teaching strategies (5th ed.). Boston: Houghton Mifflin.

Lynch, E.W., & Lewis, R. B. (Eds.). (1988). Exceptional children and adults: An introduction to special education. Glenview, IL: Scott, Foresman.

Winn, W. (1993). Perception principles. In M. Fleming & W.H. Levie (Eds.), Instructional message design: Principles from the behavioral and cognitive sciences (2nd ed., pp. 55-126). Englewood Cliffs, NJ: Educational Technology Publications.

7.1.3 Use 'direct manipulation' interfaces whenever possible

In the real world, physical actions have physical results. People experience a sense of satisfaction and security when they perform an action and objects react in understandable and predictable ways.

Well-designed "direct manipulation" interfaces bring this involvement to the computer world. These highly visual interfaces are most suitable for novices and infrequent users because they are easier to learn and remember.

Direct manipulation interfaces are built around pictorial or graphic representations of the information or task domain being presented. Pictures rather than words are the basis for user interaction. Users point at objects on the screen with the mouse or their finger, select them, and manipulate them (e.g., users move, replace, or remove objects). Pictorial elements on the screen change appearance in response to user actions.

In contrast, language-based environments—such as menu-driven, command, or natural-language systems—use words as the intermediary between the user and the computer. In language-based environments, the user interacts with the computer by typing on a keyboard, and the computer may give the user verbal feedback on the results of the action.

A program's interface may alternate between different interaction styles or allow users to choose between styles.

Benefits of well-designed direct manipulation interfaces include:

- Users learn and retain physical, spatial, and visual representations more readily than text or numerical representations.
- Users are freer to concentrate on the task when they don't need to be as concerned with the rules of the computer.
- Users make fewer errors when they don't have to learn complex syntax.
- More forgiveness encourages users to explore.
- Novices can perform actions more rapidly.

- Feedback is more immediate and visible, enabling users to change direction and immediately correct errors.

Problems with direct manipulation interfaces include:

- They can require more space, forcing designers to place valuable information off-screen, to divide related information among multiple screens, or to require lengthy scrolling activity.
- Users may have trouble learning or discriminating between pictorial elements.
- Expert users take longer to perform actions than with a command-language interface.
- Frequently repeated sequences of actions cannot be grouped as they can in command-language interfaces.

Further readings

Hutchins, E., Hollan, J., & Norman, D. (1986). Direct manipulation interfaces. In D. Norman, & S. Draper, (Eds.), User centered system design: New perspectives on human-computer interaction (pp. 87-124). Hillsdale, NJ: Lawrence Erlbaum Associates.

Norman, D. (1988). The psychology of everyday things. New York: Basic Books.

Shneiderman, B. (1992). Designing the user interface: Strategies for effective human-computer interaction (2nd ed.). Reading, MA: Addison-Wesley.

7.1.4 Allow users to choose how information is delivered

Preferences for information displays vary according to learning styles, cognitive abilities, and physical characteristics. Highly literate or text-oriented users may prefer written text. Users who are more artistic or visually oriented, or who have reading disabilities, may prefer pictorial and auditory information.

Build flexibility into programs so customers can use their preferred mode of information access. This will allow them to interact more efficiently and may help them to absorb more information.

Present information in different modes so that users can select and easily switch between modes. Allow users to select one or more modes at a time; while spoken language accompanying text may be helpful for novice users, experienced users often find it irritating. Be sure to tell users about their selection options and give clear instructions how to use them. Users who don’t want voice-overs will get frustrated if they can’t figure out how to deactivate the sound.

If your goal is to duplicate information in each modality, make sure the information provided in each modality stands alone. For instance, allow users to read a textual description, see a movie that covers the same information, or do both. Provide text and spoken language descriptions of all important graphics.

Even when you are not completely duplicating information, use multiple modalities to clarify information and enhance learning. For instance, if the primary modality is visual text, provide illustrations to complement and clarify the text.

7.1.5 Provide adaptable software

All users have preferences as to how they would like software to perform. Software in public-access environments should allow users to set parameters to tailor the software. Ideally, new users should be able to reset the software configuration quickly when they begin working.

Operating systems are beginning to provide the capability for saving personal preferences. A user can assign an identifier, often called an "id," that will identify him or her and the system can then re-establish that individual's personal working environment in a later session. Since this approach is starting to be adopted for application programs as well, it should be considered when evaluating new software.

Further readings

McDonald, J.E., Dayton, T., & McDonald, D.R. (1988). Adapting menu layout to tasks. International Journal of Man-Machine Studies, 28, 417-435.

Oppermann, R. (1994). Adaptive user support: Ergonomic design of manually and automatically adaptable software. Hillsdale, NJ: Lawrence Erlbaum Associates.

Rosson, M.B. (1984). The role of experience on learning, using, and evaluating a text-editor. Human Factors, 26, 463-475.

7.2 Design adaptable systems to meet the needs of customers with physical impairments

7.2.1 Provide accessible work stations

Make work stations accessible to people with disabilities by providing comfortable and flexible physical access to system components.

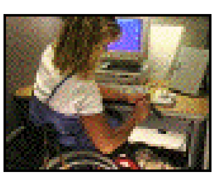
- Work station height should be adjustable to accommodate a variety of users.
- Work station tables must adhere to federal guidelines for wheelchair accessibility. Tables must be 28 to 34 inches high, at least 19 inches deep, and at least 30 inches wide.
- Hardware components should be easily moved and re-arranged to accommodate all users. For example, a work station should be wide enough to permit the mouse pad to be placed either to the left or right side or to move the keypad to one side to facilitate one-handed access.
- Keyboards or mouse pads should be removable to permit use of alternative input devices.
- Monitors should be easily movable to accommodate different users.

Further readings

Thompson Publishing Group (1990). Americans with Disabilities Act (ADA) compliance guide (Vol. 2). Washington, DC: Thompson Publishing Group.

Vanderheiden, G.C. (1988). Considerations in the design of computers and operating systems to increase their accessibility to persons with disabilities. Madison, WI: Trace R&D Center.

Vanderheiden, G.C. (1994). Application software design guidelines: Increasing the accessibility of application software to people with disabilities and older users. Internet: http://www.trace.wisc.edu/tindex.html.



To see a multimedia example that illustrates this principle, point your web browser to:

http://clipt.sdsu.edu/posit/ex/0066.html

7.2.2 Provide access to computers for customers with disabilities

To give customers with disabilities equal access to resources in a public-access computer environment, you'll need so-called "assistive" software, hardware modifications, and employees who are sensitive to disability-access issues.

Assistive technology, which ranges from speech synthesizers to auditory cues, helps people with disabilities utilize the physical equipment and interact with computerized information and procedures. All lab software and documentation should follow "usability" guidelines and principles.

Although lab workers can provide computer access for users with disabilities, assistive technology empowers users with disabilities to control their own usage and performance. Experience suggests that providing accessible technology to people with disabilities has increased their independence and personal productivity. You can purchase assistive software packages and use the special features included in both PC and Macintosh operating systems.

Organizations that provide information about accommodating users with disabilities include:

- private foundations (e.g., The American Foundation for the Blind);
- associations (e.g., The National Association for the Deaf);
- government agencies (e.g., The National Library Service for the Blind and Physically Handicapped of the Library of Congress); and
- manufacturers (e.g., Apple, Sun Microsystems, IBM, Microsoft).

Further readings

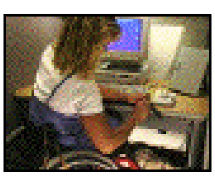
General Services Administration, Information Resources Management Services (GSA, IRMS) (1989). Managing end user computing for users with disabilities. Washington, DC: GSA, IRMS.

McWilliams, P. (1984). Personal computers and the disabled. Garden City, NY: Quantum Press / Doubleday.

Microsoft. (1996). PC 97 design guide: Designing PCs and peripherals for the Microsoft Windows family of operating systems (Appendix C: Accessibility). Redmond, WA: Microsoft Corporation.

Vanderheiden, G.C. (1988). Considerations in the design of computers and operating systems to increase their accessibility to persons with disabilities. Madison, WI: Trace R&D Center.

Vanderheiden, G.C. (1994). Application software design guidelines: Increasing the accessibility of application software to people with disabilities and older users. Internet: http://www.trace.wisc.edu/tindex.html.



To see a multimedia example that illustrates this principle, point your web browser to:

http://clipt.sdsu.edu/posit/ex/0066.html

7.2.3 Provide access for people who are visually impaired

Provide adaptations to help visually impaired and blind customers enter data into the system and obtain information from the monitor.

Hardware adaptations

For users with visual impairments:

- Use devices that magnify labels, numbers, or text relevant to the system. For instance, enhance legibility of the computer keyboard with large, stick-on letters.
- Use oversized monitors to provide a larger reading area.

For users who are blind:

- Use a speech synthesizer or Braille output device to “display” text as spoken words.
- Make the keyboard easier to use by marking important or often used keys or boundaries in Braille. For instance, mark the keyboard’s top and bottom edges, the numeric keypad, or the function keys.

Software considerations

For users who are visually impaired or blind:

- Provide auditory cues (e.g., beeps or other sounds) that signal when an action must be taken or that indicate an action is complete.
- Provide auditory instructions explaining how to access the program. This technique is frequently used with kiosks.
- Provide the option to deactivate the sound for users who do not want it.

For visually impaired users:

- Use software to enlarge the size of text on the monitor. Such software should allow the user to control the size and color of the display.
- Use a high contrast between text and the background (e.g., black on white)

- Provide a consistent, predictable screen layout.

For blind users:

- Use screen readers. Screen readers are software products that translate text from screen displays into auditory or Braille output. Screen readers are most readily used with text-based interfaces. Applications designed with graphical user interfaces may not work well with screen readers, although software developers can use a number of techniques to enable screen readers to detect what is on the screen.

- To maximize benefits of screen readers, design all screen displays so that they can be understood by reading the text only and explain all graphics with text. Make sure screen displays are consistent and predictable so that screen readers can process them.

- Allow all data entry and actions to be accomplished with the keyboard or a speech recognition device.

- Provide a synchronized running audio description for all information presented as an animated graphic or movie, or provide an equivalent textual description or transcript.

- Further readings

Lewis, R.B. (1993). Special education technology: Classroom applications. Pacific Grove, CA: Brooks/Cole.

Microsoft. (1996). PC 97 design guide: Designing PCs and peripherals for the Microsoft Windows family of operating systems (Appendix C: Accessibility). Redmond, WA: Microsoft Corporation.

Vanderheiden, G.C. (1988). Considerations in the design of computers and operating systems to increase their accessibility to persons with disabilities. Madison, WI: Trace R&D Center.

Vanderheiden, G.C. (1994). Application software design guidelines: Increasing the accessibility of application software to people with disabilities and older users. Internet: http://www.trace.wisc.edu/tindex.html.

7.2.4 Use clear boundaries and contrasts in screen displays

To avoid confusing software program users, designers should provide clear boundaries and contrasts between visual and auditory figures and the background. Also, provide changes or contrasts between visual or auditory signals to help users distinguish important from unimportant information.

The goal should be clear “figure-ground” distinctions, with figures representing important information and the ground representing unimportant information.

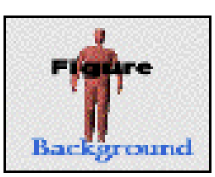
This advice applies to text, pictures, sound and other modes of presenting information. It will aid all users, but especially those with cognitive disabilities, who may have greater difficulty discriminating between competing auditory and visual stimuli.

To make sense of visual and auditory information, people attempt to distinguish between figures in contrast to background, and to distinguish between different parts of a visual or auditory message. Human perception is only sensitive to changes in auditory and visual signals. If there is insufficient change from one input signal to the next (for example, color or brightness) people may not perceive any change at all. For example, if the color of a figure is too similar to the background color, or if a figure does not have a clear outline, viewers may overlook the figure.

Boundaries include the outer edges of visual figures or the onset of sounds. Important graphics should have clear boundaries or outlines, and their color should contrast sharply with the background. Spoken sounds must be comparatively loud, and clear enough to be heard over background sounds. Make sure spoken sounds are distinguishable from one another. Avoid using low fidelity output devices for speech production. On lower fidelity speakers or speech synthesizers, sounds may seem identical to one another and be virtually unintelligible.

Further readings

Winn, W. (1993). Perception principles. In M. Fleming & W. H. Levie (Eds.), Instructional message design: Principles from the behavioral and cognitive sciences (2nd ed., pp. 55-126). Englewood Cliffs, NJ: Educational Technology Publications.



To see a multimedia example that illustrates this principle, point your web browser to:

http://clipt.sdsu.edu/posit/ex/0068.html

7.2.5 Provide access for users with hearing impairments

Users with hearing impairments or who are deaf must rely on vision to compensate for the hearing loss. Make instructional and informational media accessible to these users by emphasizing visual output such as graphics, text, or close-captioned video. Provide all auditory information in a visual form as well.

When providing a visual cue to what would otherwise be an auditory alert, make sure the cue is sufficient to attract the user's attention when viewed out of the corner of the eye. A flashing menu bar or area at the bottom of the screen is more likely to get the user’s attention than a small icon that appears and disappears momentarily in a corner of the display.

Graphics and illustrations should provide clear directives and information, rather than merely fill an aesthetic role. In addition, many people who are severely hearing impaired and most deaf people communicate in American Sign Language (ASL). Since written and spoken English may be like a second language for these users, readability of text may be an even more significant issue for them than for other users. Users who possess limited English proficiency will benefit from materials designed with hearing impaired and deaf users in mind.

Some users may prefer to use their residual hearing. Provide headphones and software which allows these users to turn up the volume to hear auditory output.

Further readings

Lewis, R. B. (1993). Special education technology: Classroom applications. Pacific Grove, CA: Brooks/Cole.

Vanderheiden, G. C. (1988). Considerations in the design of computers and operating systems to increase their accessibility to persons with disabilities. Madison, WI: Trace R&D Center.

Vanderheiden, G. C. (1994). Application software design guidelines: Increasing the accessibility of application software to people with disabilities and older users. Internet: http://www.trace.wisc.edu/tindex.html.

7.2.6 Provide access for users with physical disabilities

People with physical disabilities have a wide range of abilities and limitations. Some may have a limited range of motion, or lack of control of their limbs, or uncontrolled movements accompanying purposeful movements.

A physical disability, by itself, does not usually affect a person's ability to perceive information displayed on the computer screen. Physically impaired users have limited computer access because they may have difficulty using conventional input devices such as the keyboard or mouse. Special input devices and software modifications enable these users to perform the input, pointing, and selection functions of the keyboard and mouse.

Keyboard modifications or replacements include:

- enlarged keypads or devices that channel the user's fingers into the correct position for typing;
- switches that emulate the keyboard or voice recognition systems to replace the keyboard; and
- software adaptations that alter functioning of the keyboard. For instance, software can alter the sensitivity of the keyboard by filtering or remapping certain keyboard functions. By changing the key repeat function, you can ignore excessive pressure on a key that would otherwise result in repeated entry of that information. By making the keyboard less sensitive, you can filter out brief, accidental keystrokes.

Methods of improving access to mouse functions include:

- Allow the mouse to be moved easily to either side of the workspace to afford use by the left or right hand.
- Replace the mouse with an alternative pointing device, such as a trackball, touch pad, or head-mounted infrared pointing device.
- Use software modifications that permit users to employ the keyboard's numeric keypad as a mouse.

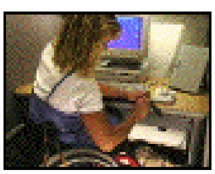
Further readings

Lewis, R. B. (1993). Special education technology: Classroom applications. Pacific Grove, CA: Brooks/Cole.

Microsoft. (1996). PC 97 design guide: Designing PCs and peripherals for the Microsoft Windows family of operating systems (Appendix C: Accessibility). Redmond, WA: Microsoft Corporation.

Vanderheiden, G. C. (1988). Considerations in the design of computers and operating systems to increase their accessibility to persons with disabilities. Madison, WI: Trace R&D Center.

Vanderheiden, G. C. (1994). Application software design guidelines: Increasing the accessibility of application software to people with disabilities and older users. Internet: http://www.trace.wisc.edu/tindex.html



To see a multimedia example that illustrates this principle, point your web browser to:

http://clipt.sdsu.edu/posit/ex/0066.html

Glossary

Active listening	Communication style that requires the listener to work at understanding the speaker by paraphrasing main ideas, seeking clarification, and giving feedback.
Advance organizer	Content that links what users will be learning to what they already know to help them make sense of new information, learn it, and remember it. By activating relevant prior knowledge, advance organizers also help learners stay focused on the subject.
Algorithm	Step-by-step procedure for solving a problem or meeting a goal.
Alias	User-defined term that is translated by the system.
Analytical strategies	Search methods which are formal, goal-driven approaches that require careful planning and recall of query terms.
Anchor	Point within a web-page file that's the target of a link. Without an anchor point, the author of the web page could link only to the top of the file, and the reader would have to guess what part of the file was intended as the destination of the link.
Assistive software	Computer programs (such as speech synthesizers) that help people with disabilities to utilize physical equipment and interact with computerized information and procedures.
Balloon help	Pop-up displays that automatically explain objects on a computer screen.
Boolean search	Computer search method which is based on logic and controlled by a command language.

Browser (or browser application)	A client program (software) that is used to access various kinds of Internet resources. Graphical browsers provide a visual display of information and employ a graphical user interface; non-graphical browsers can only display text. Examples of graphical browsers are Netscape Navigator and Microsoft Explorer; an example of a non-graphical browser is Lynx.
Browsing	Term often used in connection with hypertext: looking for information in a casual way.
Chunking	Organizing conceptually related material into blocks of information. Chunking is effective because it helps to control the flow of information the customer is absorbing, and it promotes better understanding and memory of the material.
Client	A software program that is used to contact and obtain data from a server software program on another computer, often across a great distance. A web browser is a specific kind of client program.
Cognitive abilities	Abilities such as perceiving, thinking, learning, and problem-solving.
Cognitive disabilities	Conditions that interfere with human cognitive abilities. For example, Auditory Processing Deficits and Attention Deficit Disorders.
Cognitive overhead	Anything that impedes efficient information gathering and takes cognitive processing capacity away from the task at hand.
Constructivist	Method of teaching in which learners are presented with information and asked to extract or construct their own meanings from the material.

Cultural schemata	Knowledge, beliefs, and attitudes common to members of the same cultural group.
Cyberspace	Term originated by author William Gibson in his novel Neuromancer. The word cyberspace is currently used to describe the whole range of information resources available through computer networks.
Direct manipulation environment	Computer interfaces built around pictorial or graphic representations of the information or task being presented. Graphical objects rather than words are the basis for user interaction.
Directive cues	Highlighting techniques (such as boldface, color, underlining, or flashing) that draw the reader's attention to specific parts of text to direct and guide the reader through the material.
E-mail (Electronic Mail)	Messages, usually text, sent from one person to another via computer. E-mail can also be sent automatically to a large number of addresses (mailing list).
Ergonomically designed	A work environment designed with the physical needs and limitations of customers in mind.
Euphemism	A word that acts as an inoffensive substitute for a word that could be distasteful, offensive, or too blunt.
Feedback	Information a user receives after completing a task that reports (1) the appropriateness of the user’s actions or (2) the status of the system’s response to the user’s actions.
Figure-ground	Graphic distinctions, with figure representing important information and ground representing unimportant information.

Forgiveness	Design feature of a software program that enables every action to be reversible.
Full-text indexing	Indexes that encompass all the words contained in an entire document or collection of documents.
Generalization	Treating a set of related objects as a generic group.
Generative problem-solving	Processes that allow a learner to create her or his own meaningfulness for new material.
Graphical user interface (GUI)	An interface that relies on the visual organization of information and works through direct manipulation (point and click) rather than language-based command prompts. Examples are the Macintosh and Microsoft Windows desktops.
Guided tour	When a hypertext document contains many nodes and little overall structure, it is helpful to guide the user through the major or important nodes by providing a list of them. By taking this guided tour through the information space, the reader can learn a little bit about the hyperdocument before being expected to handle it independently.
Heuristic	Flexible guidelines or suggestions for solving a problem; not a step-by-step procedure (algorithm).
HTML (Hypertext Markup Language)	The coding language used to create hypertext documents for use on the World Wide Web. HTML resembles old-fashioned typesetting code, where you surround a block of text with codes that indicate how it should appear. Additionally, in HTML you can specify that a block of text or a graphic is linked to another file on the Internet. HTML files are meant to be viewed using a World Wide Web client browser program, such as Netscape Navigator or Mosaic.

Human factors engineering	The science of designing systems that are safe, comfortable, effective, and usable. The goal is to design systems so end users can avoid frustration, make few mistakes, and experience an increase in productivity.
Hyperindex	"Table of contents" in a computer program that connects related terms or concepts via electronic links within the program.
Hypermedia	A generalization of hypertext. Instead of restricting informational content to text, the term "hypermedia" allows for pictures, movies, and sounds to be linked to the work. Hypertext and hypermedia are closely related, and the terms are often used interchangeably.
Hypertext	Text elements that are electronically stored in discrete units or "chunks" that the user can explore in a non-linear fashion.
Information space	The entire range of information covered in a work.
Interface	The technical "bridge" or means of communication between a computer system and users of the system.
Internet	The vast collection of inter-connected networks that all use the TCP/IP protocols and that evolved from the ARPANET of the late 1960's and early 1970's. Today, tens of thousands of independent networks form the global Internet.
Intranet	A private network inside a company or organization that uses the same kinds of software that you would find on the public Internet, but that is only for internal use.
LAN (local area network)	A computer network limited to the immediate area, usually the same building or floor of a building.

Language-based environments Computer interface such as menu-driven, command, or natural-language systems that use words as the intermediary between the user and the computer. In language-based environments, the user interacts with the computer by typing on a keyboard.

Life-long learning Term referring to the fact that there are many different, constantly evolving areas of expertise. Getting to know new areas is a life-long process.

Link Connection between two hypertext or hypermedia nodes.

Listserv The most common kind of maillist, listservs originated on BITNET, but they are now common on the Internet.

Lost in cyberspace Term used in connection with hypertext and hypermedia systems. Because information is structured in a non-linear manner in hypertext and there are many links and anchors to other information, it is easy to get disoriented or 'lost.'

Maillist (mailing list) Typically, an automated system that allows people to send e-mail to one address, whereupon their messages are copied and sent to all of the other subscribers to the maillist. In this way, people who have many different kinds of e-mail access can participate in discussions together.

Mapping The relationship among the parts of a system, or between controls and results. Mapping concerns itself with the connection between what one wants and what appears to be possible.

Metaphor The use of a phrase, symbol, or sentence with one meaning to define another. Computer systems use metaphors to help learners instinctively interact with a program and make them comfortable in the technical environment. For example, a trash can icon invites users to "throw away" documents they no longer want.

Multimedia Containing information in more than one medium, including text, graphics, video, and sound.

Multiple modalities Presenting the same information several ways--text, graphics and spoken words--to accommodate users with differing learning styles and to reinforce meaning.

Node Hypertext object that is the target of a link. It is a single, conceptual unit that may be a short text passage, a graphic, sound, or other type of information.

Perceived self-efficacy The belief that one will be able to perform a task successfully.

Perceptual saliency Prominence of visual elements. Perceptually salient items will stand out and gain attention from the user. Perceptual saliency is mainly created by change and contrast.

Readability formula Sets of rules that can be used to estimate the ease with which a document can be read by a population of readers.

Residual hearing Diminished but functional hearing that remains after significant hearing loss.

Schema A mental model or internal representation of a body of knowledge created by the human brain.

Schemata	Structured groups of concepts which constitute generic knowledge about events, scenarios, actions, or objects that has been acquired from past experience.
Screenful	One screen's worth of text or information. The number of lines will vary depending on hardware and software considerations.
Semantic connection	The link between the meanings of words, signs, and symbols and the context in which they are used.
Semantic relationship	The relationship between the meanings of words, signs, or symbols.
Sensory modality	The way information is presented to learners. Computer programs can present data visually as text and graphics and acoustically as sounds.
Server	A computer or a software package that provides a specific kind of service to client software running on other computers.
Task	Described in terms of the goals or the desired end result of activities a user wants to achieve. More than one user procedure (a sequence of actions to be executed to carry out a task or to reach a goal) may exist to achieve the task.
Usability testing	Testing a tool, system, or device see to determine how easily it can be used .
URL (uniform resource locator)	The standard way to give the address of any resource on the Internet that is part of the World Wide Web (WWW). A URL looks like this: http://clipt.sdsu.edu/posit/examples.html

Usability	A multidimensional attribute that relates to the extent to which a product or service facilitates the goals of end users. In general usability refers to the efficiency with which customers can accomplish their tasks with the product/service and the overall satisfaction of users.
User interface	Totality of the communication and interaction between the user and the computer. The user interface includes hardware components (such as keyboards, mice, and visual displays); software components (such as menus, direct manipulation techniques, screen layouts, and graphics); and users' experiences during the interaction (including mental processing, physical processing, and emotional reactions such as frustration, satisfaction, or self-efficacy).
Users	The general population of individuals who are expected to make use of the product after final product release.
User-centered design	A philosophy of design centered on the needs and interests of the user, emphasizing products that are usable and understandable. The user must be able to figure out what to do with an object or system and understand what is going on.
Virtual	A simulation of reality that captures the essence or effect of an experience, without the actual components of the experience.

Working memory	Memory that manipulates and organizes new information and integrates it with existing knowledge. Working memory allows an individual to pay attention and focus on incoming information, activates related information in long-term memory, and integrates the new information with the existing information. Working memory also transfers newly integrated knowledge to long-term memory for future reference. Working memory is limited in capacity; rehearsal or practice is necessary to prevent loss of information in working memory.
WWW (Web, World Wide Web)	Information system that runs on the Internet using the Hypertext Transport Protocol (http) in which information, resources, and files are associated by hypertext links.